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A HANDBOOK FOR BETTER FEEDING OF LIVESTOCK

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TEN POINTS IN BETTER FEEDING

"MAKE EVERY POUND OF FEED YIELD A PROFIT"

1. GROWING ANIMALS make best use of feed—keep them growing.
2. WEANING TIME is a critical period; start feeding before weaning.
3. BALANCED RATIONS supply animals' needs with least feed.
4. WATER and SALT should always be accessible.
5. LEGUMES, PASTURES, and SUCCULENT FEEDS aid production and profit.
6. FEED LIBERALLY for large production; mere maintenance yields no profit.
7. BREEDING ANIMALS should be kept thrifty, but not overfat.
8. GOOD FEEDING EQUIPMENT prevents waste of feed and labor.
9. PARASITES, EXPOSURE, and OVERCROWDING retard growth and waste feed.
10. FEED COSTS are important; not all balanced rations yield equal profit.

This handbook covers the principles of the practical feeding of livestock in a general way. In addition, brief descriptions of the proper feeding practices for different kinds of livestock are given. More detailed and complete information on the various problems connected with livestock feeding may be obtained from your county agent, State college of agriculture, or from the United States Department of Agriculture, Washington, D. C.

A HANDBOOK FOR BETTER FEEDING OF LIVESTOCK

By PAUL E. HOWE, *Assistant Chief, Bureau of Animal Industry,* and HAROLD M. HARSHAW,[1] *Associate Biochemist, Animal Husbandry Division, Bureau of Animal Industry,* and T. E. WOODWARD,[2] *Senior Dairy Husbandman, Division of Dairy Cattle, Breeding, Feeding, and Management, Bureau of Dairy Industry, Agricultural Research Administration*[3]

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GENERAL CONSIDERATIONS IN FEEDING LIVESTOCK

THE IMPORTANCE OF EFFICIENT LIVESTOCK FEEDING

The feeding of the various classes of livestock is a major farm enterprise in the United States. More than half of the average annual gross farm income is derived from the sale of animals and animal products. It is important, therefore, that feeding practices on the farm be as efficient and economical as possible in order that farm profits may be greater.

Economy in the production of animals and their products may be improved not only by a careful consideration of the feeding problem, but also by careful management. Good management is an aid to greater efficiency in animal production.

[1] Resigned.

[2] Retired.

[3] This handbook is a revision of and supersedes former editions by E. W. Sheets, formerly Chief of Animal Husbandry Division, and William Jackson, Assistant Chief of Animal Husbandry Division, Bureau of Animal Industry. This revision includes recommendations applicable to conditions prevailing in February 1947.

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MANAGEMENT AS AN AID IN FEEDING

SELECTION OF SUITABLE STOCK FOR FEEDING

The first consideration should be the selection or breeding of the animals for feeding. The health and individual characteristics of the animals fed have a great effect on the results obtained. The best feeders are strong, healthy individuals of quiet disposition and from good breeding stock. Sleek hair and bright eyes are indications of general thriftiness and efficiency in livestock. Good teeth are of prime importance. It is also advisable to select animals that are adapted to the purpose for which they are to be fed. A dairy-type cow cannot be expected to produce choice beef and a beef cow usually produces only a moderate quantity of milk. Purebreds of good type bring greater returns to their owners than scrubs or common stock. Crossbreds and grade stock of good breeding also usually give excellent results from a utility standpoint.

Animals even of the finest breeding, although given the best feeds in correct proportions, do not make a profit for the feeder if they are not properly cared for and kept in good health. Disease, lice, worms, and various discomforts are means of wasting feed. Feeders who cannot understand the poor condition of their animals when given good feeds should examine them carefully for ailments and remove the cause.

ATTENTION TO DETAILS PAYS

The successful feeder realizes that persistent attention to details, which are often considered unimportant, pays well in the end. The maintenance not only of the health and comfort of animals but also consideration of their individual likes and temperaments will help in feeding successfully.

It is important to avoid the wastage of energy by the animals through unnecessary muscular activity. Rough treatment, excitement, and noise usually result in inefficient use of feed. Fattening animals and milking cows should not be permitted to exercise any more than is deemed necessary for the maintenance of health. Dehorning of animals is often desirable to prevent injury or excitement due to fighting. Males that are to be fattened should be castrated. They will be much quieter, produce a better quality of meat, and bring a higher price when sold.

IMPORTANCE OF SANITATION

The labor required for keeping the feed lot, stables, houses, and feeding and watering equipment in a clean and sanitary condition is well spent, for it frequently prevents losses from

disease and digestive disturbances. The feed lot should be large enough to prevent insanitary muddy conditions, or small enough so that it can be paved. Stables and other shelters should be cleaned regularly. Disease may often be spread through contamination of feed and water, and care in the prevention of such conditions is well worth while. Some classes of animals may refuse to eat badly soiled feed.

FEEDING EQUIPMENT

Proper equipment, well arranged, saves feed and labor.

Grain and similar feeds should be kept in rat-and-mouse-proof cribs or bins. These rodents eat large quantities and waste still more.

Labor-saving devices, such as self-feeders and racks, are economical.

Where large numbers of livestock are fed it is usually advisable to use a wagon or an overhead carrier from the feed room or bin to the feed troughs or bunks. Silage may be fed in the same way.

Chutes from the haymow into or near the mangers save labor.

The use of self-feeders is discussed in this handbook under feeding the different classes of animals. They are most useful in fattening hogs for market and in feeding chickens. They are great labor savers and are especially valuable when there is much farm work to do, for they can be filled at odd times and field work can go ahead with less interruption.

All young, growing animals should be given additional feed in creeps or pens adjacent to the pens or pastures in which they are running with their dams. The creeps are so constructed that the old animals cannot gain entrance to them. Size of opening should be regulated by both width and height.

Feeding equipment, especially when feeding young animals, should be kept clean. If the animals are given more feed in their boxes or troughs than they will clean up before the next feeding, this stale feed, if left, will be wasted and will also cause part of the new feed to be wasted.

Pails for feeding calves, bottles and rubber nipples for feeding orphans, and other feeding utensils, if allowed to become dirty, may cause serious digestive troubles or permanent disease. Thorough cleaning and sterilization of the equipment will prevent this danger.

CARE IN FEEDING IMPROVES THE RESULTS

The careful feeder supplies each animal according to its needs. The safest way to do this properly is to have some means of

measuring or weighing the feed. In using concentrated feed the quantity to be given at each feeding may be easily calculated by determining the weight of the contents of a measure. The weights and measures of common feeds may be found on page 59. Hay that has been baled may be weighed easily, but in using loose hay the weight of an average forkful should be determined.

UNDERFEEDING FARM ANIMALS

Many farm animals are underfed and cannot produce economically with the feed given to them. A ration which supplies only the animal's maintenance requirements does not allow for the needs of growth, work, fattening, or the production of milk, eggs, and wool. Using improperly balanced rations is a form of underfeeding, for the animal will not thrive or produce profitably in such a case even though the ration is plentiful. Animals have nutritive reserves upon which they can draw during periods of restricted feed intake. Such conditions exist often among wild animals and in domestic animals on the range, especially in the winter or during drought.

Restricted feeding may be considered as one form of underfeeding as compared to full feeding. There are occasions when the total returns from animal feeding are greater when the animals are fed somewhat less than they need for maximum production. There are other cases, particularly in fattening animals where the fatness of the animal can be controlled by restricting the quantity of feed. For reasons of economy breeding animals are usually not fed to capacity. Furthermore, animals that are too fat do not breed so readily as those in normal condition or even thin ones.

OVERFEEDING

Overfeeding is wasteful in several ways. Animals, when overfed, may eat more than they can digest properly and leave in their trough feed which they will not eat later. They may also suffer from digestive disturbances of more or less severity that result in loss of weight and with lactating animals in a reduction of the milk flow. Animals having mild digestive troubles are commonly referred to as being "off feed." Overfeeding also results in less efficient utilization of the nutrients consumed.

Old animals are more apt to be wastefully fed than the younger ones. It is best to keep animals ready for a little more feed than they have been given. Carefully controlled feeding just below the maximum an animal will readily con-

sume is more effective than the alternate periods of gorging and "off feed" that sometimes occur in feeding livestock.

REGULARITY OF FEEDING

A little attention to details in feeding and caring for animals sometimes counts for a great deal. Regularity of feeding usually repays the feeder for the added trouble.

NUMBER OF FEEDS PER DAY

Horses at work and dairy cows producing heavily should be fed three times per day. Young animals under 6 months of age should be fed at least three times a day, and the intervals between feeds should be as nearly equal as possible. Two feeds a day for other animals are usually sufficient. In fattening steers, satisfactory results are commonly obtained with one feed of concentrates a day. This is especially true when the steers are on pasture or receive a ration containing considerable roughage.

FEEDS SHOULD NOT BE CHANGED ABRUPTLY

Sudden changes in the diet may throw an animal off feed. Although changes are often necessary and desirable, the new feeds should be begun a little at a time. In like manner, when some feed is to be omitted from the diet make the change gradually.

In dry-lot or stall feeding, it is a good rule to use several day's time to change from one important ingredient to another. The feed being taken out should be reduced about one-fourth the first day, one-half the second day, and so on, an equal quantity of the new feed being added each day. In turning animals out to pasture or changing pastures, make the change gradually. First, be sure the animals have had their fill of hay or of the old pasture, then begin with an hour's grazing on the new pasture after the grass is dry, gradually increasing the time on the new pasture during succeeding days.

TO REDUCE THE DANGER OF BLOATING

To reduce the danger of bloating, cattle and sheep should be given a good fill of dry feed, particularly roughage, before they are turned on green forage, such as red clover or alfalfa. If some dry roughage is convenient for them in the pasture, they often correct of their own accord, any tendency to bloat. The danger of bloating is increased by dew or rain on the pasture.

Horses and hogs are not subject to bloating, but before being turned out on green forage for any length of time they should be gradually accustomed to the change. Since much stock is lost from bloating, owners should study this subject fully.

HARVESTING CROPS WITH LIVESTOCK

Crops may be harvested by livestock economically when the value of the feed lost through trampling by the animals does not exceed the cost of harvesting in the usual manner. When the field being harvested by stock becomes muddy, the animals should be moved to a well-sodded pasture or dry lot and fed by hand. Harvesting with livestock is most common with corn alone, or with corn and soybeans, cowpeas, or velvetbeans. Poor stands of the small grains also may be advantageously harvested in this way. Animals to be fattened by this method should be turned into the field first and later, when the crop is nearly harvested, replaced by other stock to clean up what the fattened stock have left.

It is often good practice to harvest the best part of a crop before the stock is turned in to harvest the remainder.

SPECIAL PRECAUTIONS IN FEEDING

DANGER IN FEEDING UPON DEAD ANIMALS

Feeding livestock the carcasses of animals that have died of disease is a common source of infection of healthy stock. Experiments have shown that hogs may contract tuberculosis by killing and eating chickens that have that disease and are too weak to escape being caught.

The safest way to dispose of dead animals is to burn them to ashes. Another good way is to place them in a deep hole or pit and cover them first with quicklime and then with several feet of earth. If a carcass is left on the ground, birds, dogs, and other animals may feed on it and spread disease and parasites over a wide area.

STOCK POISONING FROM PLANTS AND FEEDS

Plants which are injurious to domestic animals are found in all parts of the United States, but the heaviest losses from poisoning occur on the western ranges. Larkspur, whorled milkweed, and locoweed are among the most destructive. Animals should be kept away from areas where such plants are known to grow, especially when the pasturage is short. Bulletins describing these plants and giving methods of treatment

for poisoned animals may be obtained from the United States Department of Agriculture.

In certain sections of the West, some soils contain the element selenium, and plants grown on these soils may contain sufficient quantities of this element to be toxic when consumed by animals. All species of livestock are affected and serious losses may result from the use of feeds containing selenium. Such plants or feeds should be avoided.

Heavy fertilization of pastures with phosphate fertilizers, high in fluorine, may result in poisoning of the stock using the pasture. In such cases the fluorine softens the teeth and injures the bones.

FEED REQUIREMENTS OF LIVESTOCK

The feed consumed by livestock is used for a number of different purposes depending to some extent on the character of the animal. A certain part of the feed of all animals is used for the maintenance of bodily functions aside from any useful production. In addition the various classes of animals use feed to take care of the functions for which they are kept; young animals need nutrients to build flesh and bone in growth; breeding females require feed for the development of their young; work animals use feed to supply energy for productive work; fattening animals need additional feed for the formation of flesh and fat. Other classes of animals require feed for the production of milk, eggs, and wool.

To supply all these needs the different classes of stock must receive sufficient feed to furnish the necessary quantity of proteins, carbohydrates, fats, minerals, and vitamins. However, besides providing the animals with a sufficient quantity of the nutrients, special consideration must be given to certain of the nutrients and to other characteristics of a satisfactory diet.

The percentage composition of the principal feedstuffs used in animal feeding are given in table 2, page 63.

KINDS OF PROTEIN AND THEIR IMPORTANCE

Growing animals require an abundant supply of protein. There are two kinds of proteins; those of plant origin and those of animal origin. Proteins of plant origin are low or lacking in certain essential substances which are contained in animal proteins. In feeding hogs and chickens, the proteins of animal origin may be used to supplement those from such feeds as corn, barley, and other grains, as these animals require proteins that are not contained in plants. In feeding mature cattle, sheep, and horses, a safe plan to follow is to provide a liberal supply of legumes as hay or pasture with a supplement of concentrates.

Those animals do not require feed of animal origin. In order to be sure that a diet has the proper kind of protein for animals that do not ruminate it is well to include a variety of feeds.

IMPORTANCE OF MINERAL ELEMENTS

An adequate supply of minerals in the diet is of greatest importance in the case of young growing animals and of females carrying or suckling young, but minerals are necessary also for animals of all ages and conditions. Mineral matter not only makes up a large part of the skeleton of the animal but is important also in the functioning of all parts of the body.

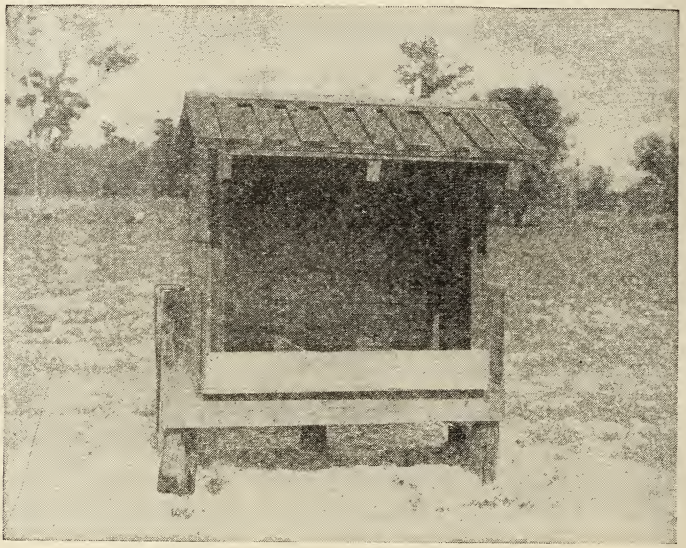

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FIGURE 1.—Salt box with shelter, suitable for providing salt or mineral mixtures for cattle, horses, and sheep.

Bone chewing and other forms of a depraved appetite are often indications of a lack of minerals in the diet. Common salt, calcium, phosphorus, and iodine are most often lacking.

Salt should be accessible to farm animals at all times, no matter what other feeds they receive (fig. 1). Hogs should have a mineral mixture containing salt available at all times, either incorporated in the ration or in boxes or self-feeders where it will be dry. With some animals, such as poultry, it is best to mix the salt with the concentrates that are being fed.

Diets will often be deficient in calcium if they are made up largely of straw, roots, and the cereal grains and their by-products. Whole milk, skim milk, and buttermilk contain plenty of calcium, and the legume hays exceed all other farm-grown feeds in content of this element. Calcium in the form of ground limestone, calcium phosphate, or bonemeal may be added to a diet if the element is lacking.

Diets that contain enough protein usually contain plenty of phosphorus, and this is especially true if a high protein concentrate is one of the ingredients of the ration. Legumes, grasses, straws, beet pulp, potatoes, and molasses contain but little of this element. It may be added to a diet together with calcium in ground bone or one of the calcium phosphates. The continued use of raw rock phosphate containing too much fluorine is detrimental to the health of animals and should be avoided. Defluorinated phosphates, however, are satisfactory.

One satisfactory method of feeding minerals, if they are needed, is in combination with common salt. Three general types of mixtures are used for cattle, horses, sheep, and hogs, depending on the feeds with which they are to be fed:

(1) With diets containing sufficient phosphorus, use two parts of ground limestone to one part of common salt.

(2) With diets requiring both calcium and phosphorus use two parts of steamed bonemeal and one part of salt.

(3) With diets requiring more calcium than phosphorus use equal parts of finely ground limestone, steamed bonemeal, and salt. This mixture is especially suitable for hogs.

GOITER DUE TO IODINE DEFICIENCY

In parts of the Northwestern and North Central States farmers have lost many newborn colts, calves, lambs, and pigs from a disease called goiter. The young are born weak or dead, and are often hairless, or have enlarged necks. This condition has been found to be caused by a lack of iodine in the diet of the dam. The difficulty may be prevented by giving the pregnant animals potassium iodide in very small quantities.

Iodine may be fed to farm animals by supplying them with stabilized iodized salt. As only a small quantity is required to correct an iodine deficiency in a diet, this method is perhaps the most satisfactory for the stockmen. It is especially important to correct any deficiency in the diet of pregnant animals.

Another method of supplying iodine is to sprinkle 1 tablespoonful, per animal, of iodine solution over the feed of sheep and swine once a week. Such a solution should consist of 20 grains (1.3 grams) of potassium iodide dissolved in 1 gallon of

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water. Iodine should not be added to the diet unless needed, as there is no apparent advantage in such a case. Too much iodine may overstimulate the thyroid gland.

CORRECTING MINERAL DEFICIENCIES

A number of complex mineral mixtures on the market are designed to furnish all the mineral requirements of the different classes of livestock. However, it is impossible to obtain such a mixture which will satisfy all sorts of feeding conditions. There is a danger, in using a complex mineral mixture, that some of the elements may be supplied to the animals in excess and others in insufficient amounts to do any good. In the case of suspected mineral deficiencies, it is desirable to consult your county agent or State agricultural college, or the United States Department of Agriculture, to determine the best means of handling the situation. The calcium and phosphorus contents of the various feedstuffs may be found in table 2. These two elements are usually the most important minerals to consider. In certain areas a deficiency of cobalt occurs and small amounts of cobalt salts need to be added to the ration.

VITAMINS NECESSARY FOR GROWTH AND HEALTH

Feeding experiments have demonstrated that small quantities of substances known as vitamins must be present in the diet in order that animals may live and grow properly. The absence of any of these from the diet may lead to a failure in growth and to characteristic disorders usually called deficiency diseases. Different species of animals vary in their needs for the vitamins and do not all suffer from the same deficiency diseases.

Under practical conditions, the diets of farm animals usually contain adequate quantities of the vitamins. However, when there are deficiencies, they are most apt to be in vitamins A, D, or G (riboflavin). During periods of drought or in other conditions of restriction in diet, difficulties may arise. This may be especially true in certain high-producing animals, such as poultry and dairy cattle. Such animals may be furnished a diet which contains too high a proportion of manufactured byproducts and thus may receive too little of one or more of the vitamins.

It is advisable to have a plentiful supply of the various vitamins in the diet of animals which supply food for human consumption. It is possible to increase the content of certain vitamins in such products as milk and eggs by liberal feeding of those vitamins.

A supply of vitamin A is important in the feeding of all classes of livestock. Good pastures, silages, green leafy hays, and yellow corn are the principal sources of carotene from which animals are able to form vitamin A. If such feeds are low or lacking in the diet, animals may suffer from disease and fail to grow properly. In cases where it is not possible to feed yellow corn or good-quality roughages, such as hay or silage, vitamin A may be added to the diet by feeding fish oils which are high in that substance.

The best means of insuring an adequate supply of vitamin D is to expose the livestock to direct sunlight. Growing animals confined indoors for long periods, or those in northern regions during the winter months, may develop rickets due to a lack of vitamin D. Most farm-grown feedstuffs are relatively low in this vitamin. Sun-cured hays are richer in vitamin D but lower in carotene, or vitamin A, than hays cured artificially. Vitamin D may be added to the diet by feeding high-potency fish oil or activated animal sterol.

The usual diets of livestock which include green forage, high-quality legume hay, or alfalfa leaf meal, grains, grain byproducts, and animal protein concentrates will supply all the riboflavin needed for growth and reproduction. Poultry diets are of chief concern in providing an adequate supply of riboflavin. Of the other classes of livestock, swine are known to require this vitamin although it is seldom lacking in the average diet. Diets which are too low in this substance may be corrected by including a dried-milk product, alfalfa leaf meal, or yeast. Among the other vitamins required by swine are nicotinic acid and thiamine (vitamin B_1). Unfortunately, corn is rather low in nicotinic acid and pigs may sometimes receive inadequate amounts if the supplemental feeds are limited in quantity and variety. However, the thiamine supply is not likely to be inadequate in the common hog rations based on whole grains and mill feeds.

In general, the other vitamins which have been discovered are usually supplied in adequate quantities in livestock diets. However, if obscure troubles arise which are suspected of being due to vitamin deficiency, the local county agent or the State agricultural college should be consulted.

The special needs of the different classes of farm animals for vitamins will be covered in sections of this handbook dealing with the feeding of those animals.

IMPORTANCE OF AN ADEQUATE WATER SUPPLY

Sometimes in farm practice too little attention is given to furnishing livestock with a proper and adequate water supply.

The water consumed by animals aids in the mastication, digestion, absorption, and transportation of foods within the body. It helps in maintaining the vital functions of the various organs, and aids in regulating body temperature. Necessarily, therefore, considerable care should be taken to provide an adequate supply of fresh, pure water. This cannot be overemphasized. It is best, so far as possible, to have water readily available at all times, especially for animals on pasture. If the animals have to go too far to obtain water, they will often not take the trouble and will, therefore, not drink enough to meet their needs. In cold weather, if the water is cold, animals may not drink enough. Under such conditions the water should be warmed slightly or the animals should have the opportunity to drink more frequently.

In hot weather animals need more water than during other periods. This is especially true of horses at hard work, which sweat heavily. Under such conditions, the animals should be given more frequent opportunities to drink than in cooler weather. However, horses that are warm from working should not be allowed to drink all they want until they have cooled off.

The stockman should be sure that his water supply is uncontaminated at its source, and then make it available to his animals in troughs or other equipment which are always kept clean. By not allowing animals to drink from stagnant pools and contaminated streams, the introduction and spread of disease through the water supply may be prevented.

The water which animals drink requires heat to warm it to body temperature. This process utilizes heat energy derived from the feed consumed. However, under most conditions the excess heat produced by the normal bodily activity of the animal is sufficient to warm the water consumed and no energy is wasted in the process. It is only under conditions of extreme cold or when beef cattle are on low levels of feed consumption that they need additional feed to warm the water which they drink or that the water should be warmed for them.

ADDITIONAL REQUIREMENTS OF A GOOD DIET

To obtain the best results in feeding, it is necessary that the feed be palatable to the animal. This is especially true of high-producing animals and fattening animals which must consume large quantities of feed to produce satisfactory results. Animals will consume larger quantities of a diet that is palatable and in some cases may utilize it more efficiently. A diet may be improved from this standpoint by the use of succulent feeds, such as pasture, or silage, or soiling crops that improve palatability and often add needed additional vitamins

and minerals. Molasses is also added to mixtures of dry feeds to enhance their palatability.

A variety of feeds is important, especially for nonruminating animals. This does not mean that it is necessary for a diet to include a large number of feeds, but it should contain feeds from several different sources. The needs of the animal for proteins, vitamins, and minerals are more apt to be adequately supplied if the diet is not too limited. For example, the proteins of some feeds are supplemented by those of other feeds. Thus, the inclusion of proteins from animal sources, except for horses, sheep, and mature cattle, helps in making sure that a diet which otherwise contains only feeds of plant origin is satisfactory in its protein content.

In order to increase the profits of farm feeding enterprises, economy demands a careful consideration of the feeds to be used. It is generally best to use home-grown feeds so far as is practical, supplementing them with purchased feeds only to the extent necessary to furnish an adequate diet.

FORAGE CROPS ECONOMICAL

The various forage crops and other roughages in the form of pasture, hay, silage, straw, stover, fodder, and soiling, furnish the least expensive base for the livestock ration. Certain of these feeds are often wasted except as they may have been grown as soil-improving crops and their use in feeding animals constitutes just that much gained. In the case of some classes of livestock, such as sheep and dry beef cows, the diet may be composed almost entirely of this sort of feed.

PASTURES ONE OF THE CHEAPEST FEEDS

For adequate nutrition and economy, good pasture is the outstanding livestock feed throughout as much of the year as it is available or can be made available. It may serve as the only feed for some classes of cattle, for sheep, goats, horses that are not working, and for dry cows. The use of a concentrate in addition to pasture is necessary for the maximum fattening of cattle and sheep, for cows producing large quantities of milk, horses that are working, growing and fattening hogs, sows with pigs, and poultry. However, suckling lambs on choice, lush, and nutritious pasture, with their mothers, have sometimes fattened satisfactorily and economically without supplementary grain feeding.

A good pasture should provide a combination of palatable forage plants such as the nutritious grasses and legumes. The growth should be dense enough to furnish the animals sufficient feed without too great effort.

Immature grass is more palatable and nutritious than mature grass. The vitamin, protein, and phosphorus contents of young grass are higher and the nutrients are more efficiently utilized than those in old grass.

Too great dependence on pasture as a sole source of feed should be avoided, however. It is difficult to maintain a uniform supply of feed throughout the pasture season. Temperature and moisture conditions as well as the natural growth habits of the plants all affect the quantity and value of the feed to be obtained by grazing at different times of the year. This disadvantage may be overcome to some extent by including a variety of plants in the pasture. For example, in the North, bluegrass grows best in the spring and fall, and may be supplemented, if not too far north, by other plants such as annual lespedeza, which is late starting and makes most of its growth in midsummer. In the South, legumes, such as white Dutch clover, and bur-clover, which grow best in the fall, winter, or spring, may be used along with Bermuda, carpet and Dallis grass, which make their growth in the summer. In addition to a variety of plants in the pasture, it may be well to furnish supplementary pastures of such crops as the afterfeed of hay fields, Sudan grass, oats, rye, wheat, sweetclover, and soybeans.

If the ground is so poor or so dry that only a sparse growth of pasturage is possible, it cannot be used profitably for feeding high-producing animals. The stock will not be able to cover a wide enough area to obtain sufficient feed. Under such conditions, the growth may be so sparse that breeding stock, if pregnant, cannot be used to gather such forage economically. In the case of a sparse growth of forage in arid regions, the feeding value is retained so well after the plants become mature and dry, that fair grazing may be obtained the year round. Heavy rainfall and dew, however, leach and cause weathering of mature plants so that many of the nutrients are lost.

MANAGEMENT OF PASTURES

Stock should not be turned out on pasture before the grass is 3 or 4 inches high, in order that the roots may have a chance to develop. Pastures should not be grazed too heavily, for such a practice lowers the production of forage, gives weeds a chance to grow, and may result in serious soil erosion. On the other hand, undergrazing, especially in the spring when pasture growth is heavy, may allow the plants to mature and go to seed. Such stemmy growth is not so valuable a feed as the young leafy growth. It is best to turn enough stock on the spring pasture to keep it well grazed and furnish supplementary

pasture or other feed later when the permanent pasturage is not so plentiful.

In the case of grasses in the western range country, grazing close enough to prevent the plants from becoming mature is not advisable because the best grasses may be killed out. It is usually best to allow a large proportion of the vegetation to mature and use it later.

CULTIVATED FORAGE CROPS AND HAYS

Cultivated forage crops and hays have one principal advantage over pasture in that they produce more feed per acre. This difference is great in regions with high rainfall, but it is even greater in dry areas. Such crops as hay or silage may be preserved and fed in periods when pasturage is not available. They may also be cut green and fed as silage to supplement summer pastures.

Crops used as hay should be cut at the right stage and carefully cured to insure the most economical supply of feed. Grasses and legumes should be cut before maturity, for the greatest yield of nutrients per acre is obtained at that stage of growth. Curing should be completed quickly with the least possible exposure to the weather. Dew or rain causes a loss of valuable nutrients. Curing in sunlight and in such manner that the natural green color is retained results in a more palatable and nutritious hay. Hay crops should also be cured so that few leaves are lost by shattering, for these parts of plants are the most valuable as feed.

Preserving crops in silos provides a succulent nutritious feed during the winter or in other periods when good pasture is not available. Silage increases the palatability of the ration, adds minerals and vitamins, and leads to the consumption of more nutrients in the form of roughage.

In case such legumes as soybeans and cowpeas cannot be made into good hay they may be put into the silo with corn or sorghum, thereby saving the crop and improving the protein and mineral content of the silage. A wide variety of crops may be preserved as silage, but corn is the best adapted to this purpose and is most commonly used. Crops must be placed in the silo soon after being cut so that there will not be any considerable loss of moisture. It is best to wilt legumes slightly before ensiling them. Wilting improves the palatability of the silage and avoids leakage from the silo which, besides being a nuisance, is destructive to concrete and masonry work. Silage must be chopped fine, evenly distributed, and well packed to exclude air which may cause spoilage.

Difficulties may be encountered in the use of high-moisture legumes and immature grasses for silage. Such crops do not contain sufficient carbohydrates to produce the acid required to insure that the fermentation will follow a desirable course. To overcome this lack of acid production, molasses or other high carbohydrate material such as ground grain may be added to the material as it passes through the silage cutter. From 40 to 60 pounds of molasses should be added per ton of green forage, grasses, or mature legumes requiring the lesser quantity. When corn meal is used, approximately 200 pounds for each ton is recommended. Another method of preserving legumes and grasses in the silo is by adding dilute mineral acids. The addition of acids prevents the growth of undesirable bacteria that cause ill-smelling silage. Both of these methods require more labor and the added expense must be considered before either one is adopted. Further information concerning the fermentation of silage may be obtained from Farmers' Bulletin 578, The Making and Feeding of Silage, issued by the United States Department of Agriculture.

All kinds of forage or cultivated crops may be cut green and fed as soilage under conditions where such feeding is necessary to supplement pasture. The chief disadvantage is that such procedure involves extra labor, but the time required may be well worth while for special purposes, such as maintaining milk production in late summer.

CONCENTRATE FEEDS

Working and high-producing animals need concentrated feeds in addition to the roughage which they can consume. For this purpose home-grown or purchased grains and commercial by-products may be used.

In general, it is most economical to use home-grown feeds in supplying the needs of the animals for concentrates, or at least as the basis of the concentrate mixture. This is especially true if the roughage portion of the diet, produced on the farm, contains enough of the legumes so that the purchase of high-priced protein concentrates is unnecessary. With some classes of livestock, the cereal grains, such as corn, wheat, oats, or barley, may be used as the sole concentrate. On the other hand, growing animals and high-producing animals, especially the nonruminants, will need more variety and better balance in the concentrate part of the ration. If the roughage available is poor in quality or low in protein, the concentrate mixture should contain a high-protein concentrate, such as cottonseed meal or linseed meal, unless the animals fed are to be carried on a diet for maintenance only. It may be more economical to sell the grains grown on the farm and buy other concentrates, but

usually, the purchased feeds are more expensive than equivalent feeds produced at home. In certain regions, such as the Northeastern States, under more intensive farm practices, it is often impossible to raise enough grain on the farm to supply the needed concentrates, and most of them have to be purchased.

To supply this need for additional concentrates commercial byproducts are available in large variety. These include, byproducts of the milling, brewing, and distilling industries; of the oil-bearing seeds; of the dairy industry; and of the meat packers, fisheries, and canneries. These byproduct feeds are either marketed as produced or used in a variety of proprietary feed mixtures intended to furnish ready-mixed, balanced feeds for the different classes of animals. Many of these feeds are excellent and highly palatable and are sold at reasonable prices. The value of these feeds depends on the qualities, proportions, and composition of the ingredients.

Practically all States have feed-control laws, requiring the analysis of the feed to be given on the bag. Usually the percentages of protein, fat, nitrogen-free extract, and crude fiber are given. State agencies administering these laws publish reports and bulletins giving the State requirements for commercial feeds and the results of the analysis of samples of the different feeds for sale within the State. Prospective purchasers of feed should obtain copies of these bulletins published in their State and inform themselves concerning the best feeds to buy, and learn how to interpret the tags.

Many of the feeds available on the farm are low in protein. For this reason the percentage of protein in commercial feeds is the most important measure of its value. Commercial feeds with high percentages of crude fiber should be avoided in general, as such feeds are comparatively low in available nutrients.

Cane molasses (blackstrap) and sugar-beet molasses are chiefly carbohydrate feeds, but they have a special value in increasing the palatability of feeds. However, their carbohydrate content is lower than that of many grains. They may be substituted for a part of the grain if their cost is slightly less. When so used, molasses is worth about 70 percent as much as corn per pound. Almost seven gallons are required to replace a bushel of corn. Because of its palatability, molasses often increases the consumption of feed, especially of those dried roughages which are unpalatable. Its use may, therefore, increase the rate and efficiency of gains in weight. Sugar-beet molasses is quite laxative, but cane molasess is only mildly so.

In feeding molasses, it may be necessary to dilute it with 1 or 2 parts of water so that it may be readily sprinkled on the feed. In cold weather it should be diluted with hot water.

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In summer its dilution should be avoided as the resulting solution will ferment readily. Molasses may be fed undiluted to horses and mules in troughs or feed boxes. When molasses is fed in warm weather, it may stick to the feed troughs and to the hair of the animals, where it will attract flies.

Yeast is a rich source of the B vitamins and also of good-quality protein and is therefore valuable in diets. Probably the best-known yeast product available is dried brewers' yeast. The choice between yeast and other feedstuffs to supplement the deficient diet depends upon the relative quality and quantity of protien and the kind and quantity of vitamins, in relation to the costs.

HOME MIXING OF FEEDS

Farmers who can produce a variety of suitable feeds may save money by mixing their own feeds. However, the value of farm grains plus the cost of grinding and mixing, as compared with the cost of commercial feeds, including freight and hauling, should determine whether it is best to mix feeds at home or depend on ready-mixed feeds. Many poultry feeders, for instance, find it cheaper and less troublesome to buy ready-mixed mashes than to buy the ingredients and do their own mixing. Hogs may be given the various feeds separately and permitted to make their own choice. Mixed feeds, when properly prepared to meet the animals' needs, are satisfactory and may be self-fed.

PREPARING FEED FOR LIVESTOCK

GRINDING FEEDS

Small, hard grains such as rye, wheat, barley, rice, and kafir should always be ground or rolled when fed to livestock for they are difficult to chew with the result that they are not efficiently utilized by the animals. Such grains as corn and oats should be ground for very young lambs, dairy cows, and heifers, and fattening cattle when there are no hogs following them. However, in some instances it may not pay to grind corn and oats in feeding small quantities to animals which have good teeth.

SOAKING AND COOKING FEEDS

Soaking, cooking, and steaming feeds may increase the digestibility of the starches to a slight extent, but usually not enough to pay for the expense and work required. In some cases heating decreases the digestibility of proteins appreciably. The cooking of feed sometimes encourages animals to eat more and this may be desirable when maximum gains are required. Pota-

toes should be cooked before they are fed, but not allowed to stand long before use because molds may develop. However, it is not necessary to cook potatoes, when feeding them to horses, mules, and dairy cows. Soybeans, field beans, and velvetbeans should be cooked for swine or poultry. This process increases the value of these beans chiefly with respect to available proteins. Soybean meal as purchased has usually been heated enough to make the product satisfactory for feeding.

FERMENTING AND SPROUTING FEEDS

The fermentation of feed mashes by the aid of added yeast is sometimes recommended as a means of increasing the feeding value of grains and roughages through the changes in contituents produced. Experiments indicate, however, that little or no benefit is obtained, if the ration is good, to justify the added cost. Malting of grains produces a marked increase in riboflavin.

Sprouting or germination of grains has been advocated as an economical procedure. The young leaves formed increase the palatability of the diet. Some of the B vitamins, especially riboflavin, are increased. The mineral salts usually added supply essential mineral elements. Studies of the process have not demonstrated it to be practical or economical under most conditions.

SHREDDING AND CUTTING ROUGHAGES

It is usually desirable to cut or shred fodder, stover, and other fibrous roughages for they are thus easier for the animals to handle and are cleaned up more thoroughly. However, the digestibility of such feeds is not increased by such practices. It rarely pays to cut or grind hay. Roughage should never be finely ground.

DIRECTIONS FOR FEEDING VARIOUS CLASSES OF FARM ANIMALS

FEEDING HORSES AND MULES

In feeding horses and mules the points that follow are a general guide, but the feeder should consider the age, size, condition, and temperament of the animals. Two horses of about the same size and type often vary greatly in their feed requirements when doing the same work. A horse of nervous temperament commonly consumes a large quantity of feed. To obtain energy for work a horse must receive feed in excess of that needed for body maintenance. A work horse that is underfed will lose in weight, become weakened and is more subject

to disease. A horse at moderate work uses about two-thirds of its feed for maintenance.

One of the best grains for horses is oats, because of the fibrous hull which furnishes bulk and tends to prevent the horse from gorging. A further means of preventing horses from eating grain too rapidly is a little chopped clover hay or some whole corncobs placed in the feed box.

Corn also is a good feed for horses. Wheat bran in limited amounts, because of its mild laxative effect, is very valuable for mixing with other feeds for idle horses and foals.

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FIGURE 2.—Mares and their foals on good pasture.

Although it is not so nutritious as legume hays, timothy is a very popular roughage for horses chiefly because it is usually free from dust.

Pasture is a valuable and appetizing feed for horses whether idle or working. Pasture alone does not furnish sufficient feed for horses at work, but should be supplemented with hay and a grain or concentrate mixture, relatively high in protein. Pasture is ideal for mares and foals (fig. 2).

Change the horse's feed occasionally though not suddenly. A horse likes variety in its diet.

FEEDING SILAGE TO HORSES

Good corn silage may be fed to idle horses in limited quantities as a supplement to the regular ration. Silage acts as an appetizer and a tonic, and may be supplied in quantities not to exceed from 10 to 15 pounds daily per animal with good results, but it should be introduced into the ration gradually. Moldy or frozen silage should not be fed to horses.

WATERING HORSES

A horse requires about 10 to 12 gallons of water daily. If it has not had water for several hours and has been at hard work, it should be watered before being fed. To allow a horse to drink freely while warm is dangerous, but a small drink taken slowly will do no harm. During hot weather, it is good practice to have water in the field so that horses can drink in the midforenoon and midafternoon or oftener if satisfactory arrangements can be made. Horses should have water after their evening feed. This can be most readily provided by turning the horses out for the night on pasture where there is a supply of good water.

SALT FOR HORSES

Salt should be available to horses at all times when they are not working. Their great relish for salt shows their need of it. It is best to give the salt separately from the feed. During warm weather when horses are at hard work, they will need more salt than at other times to replace that lost as sweat. A horse will consume 1½ to 2 ounces of salt daily, on an average.

CARE OF HORSES' TEETH

The most careful feeding may not keep a horse in good condition if its teeth are not sound and even, thereby permitting proper chewing of its feed. Sometimes the first or milk teeth of young horses remain longer than they should, causing the permanent teeth to grow crooked. Such a condition should be watched for and the milk teeth removed with forceps. If a horse's teeth wear irregularly so that proper chewing of its feed is impossible, these irregularities should be removed.

FEEDING LIGHT HORSES

Horses of the light breeds that are used for driving, riding, or racing are fed to produce action, spirit, and endurance. For

this reason, large paunchy stomachs are objectionable. The following points should be considered in feeding light horses:

This type of horse is given somewhat more grain and less hay in proportion to the weight than the draft horse. Oats easily rank first among the grains. Crushed or rolled barley and wheat bran are good supplementary feeds. Corn alone is too concentrated to constitute the bulk of the grain ration, but may be fed to advantage with oats and wheat bran or linseed meal. The best roughage is a hay of high quality, consisting of mixed grasses and legumes. A mixture of alfalfa or clover hay with timothy is a good roughage for horses.

FEEDING WORK HORSES

The quantity of feed for the work horse depends on the amount of work to be done and on the speed at which it is performed. A horse requires considerably more feed when working at a trot than at a walk. The following are general guides for the daily ration of horses under usual conditions:

Allow about ½ pound of grain and 1 to 1½ pounds of hay per 100 pounds of live weight for horses at light work.

Allow 1 pound of grain and 1 to 1¼ pounds of hay per 100 pounds of weight for a horse at moderate work.

Allow 1¼ to 1⅓ pounds of grain and 1 pound of hay per 100 pounds of weight for a horse at hard work.

If roughage feeds become scarce or expensive, horses can be kept either idle or at work on rations supplying as little as ½ pound of hay per 100 pounds of body weight if the grain allowance is properly adjusted.

As shown in the following rations, the kinds of grain and hay govern the quantities used.

SUGGESTED RATIONS FOR HORSES

Rations for 1,000-pound idle horse:

Ration No. 1:

Ingredient	*Pounds*
Ear corn	5
Alfalfa or clover hay	3
Corn stover	9

Ration No. 2:

Ingredient	*Pounds*
Cowpea hay	5
Corn silage	5
Timothy hay	10

Rations for 1,000-pound horse at very light work:

Ration No. 3:

Ingredient	*Pounds*
Oats	6
Alfalfa or clover hay	4
Timothy hay	9

Ration No. 4:

Ingredient	*Pounds*
Cowpeas (cracked)	3
Molasses	3
Oat straw	13

Rations for 1,000-pound horse at moderate work:

Ration No. 5:

Ingredient	*Pounds*
Ear corn	10
Alfalfa or clover hay	5
Timothy hay	6

Ration No. 6:

Ingredient	*Pounds*
Shelled corn	10
Cowpea hay	6
Corn stover	6

Rations for 1,000-pound horse at hard work:

Ration No. 7:

Ingredient	*Pounds*
Corn and oats	11
Wheat bran	2
Timothy hay	6
Clover or alfalfa hay	4

Ration No. 8:

Ingredient	*Pounds*
Rolled barley	10
Gluten meal	3
Alfalfa or clover hay	6
Prairie hay	4

FEEDING THE BROOD MARE

If possible, brood mares should be kept working up to within about a week of foaling, but heavy work should be avoided as this time approaches. The following rules should be followed:

No dusty, moldy, or decayed feed should be given. Feeds containing plenty of protein, calcium, and phosphorus should be supplied. The hay, especially during the latter part of gestation, should be bright and of good green color. No old hay should be fed unless it is supplemented with some good bright legume hay. Wheat bran, linseed meal, or other laxative feeds should be added to the ration to keep the mare's digestive tract active. A few days before foaling, the grain allowance should be decreased, and plenty of laxative feeds given.

A small feed of wheat bran is good for the first meal after foaling, followed by light rations for several days.

Within a week the mare may be turned on pasture and at the end of 2 weeks she may be gradually returned to her regular ration and put at light work.

FEEDING THE FOAL

It is important that the foal get a good start with plenty of milk from the mare. Allow the foal to nurse at frequent intervals even if the mare is working (fig. 3). If the mare is warm she should first be allowed to cool off. If good pasturage is not available to the mare or if the grass becomes short, the feed given her should be rich in protein, vitamins, and minerals. These may be supplied by feeding alfalfa or mixed timothy and clover hay and protein-rich concentrates.

When 3 to 5 weeks old, the foal should be given some grain. A good mixture is 3 parts of cracked corn, 2 or 3 parts of wheat bran, 3 parts of crushed oats, and 1 part of linseed meal. As soon as it will eat hay, provide some good, leafy, legume hay.

Provide plenty of clean, fresh water for both mare and foal.

Foals, once stunted, never fully recover. Remember that foals get more than half their full growth the first year.

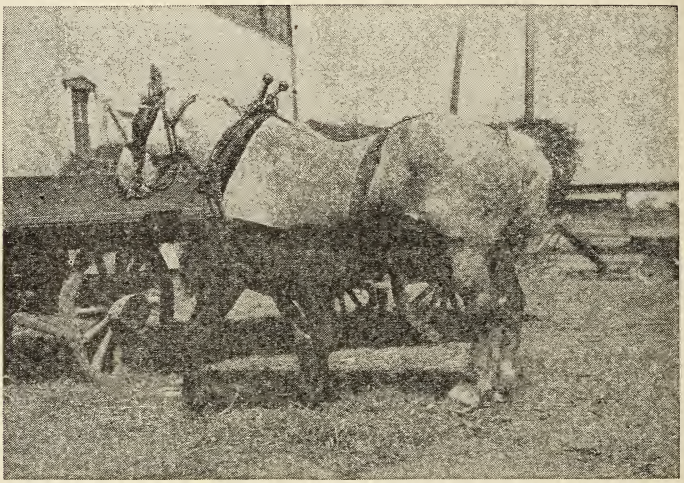

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FIGURE 3.—While the foal is young it should nurse at frequent intervals.

FEEDING THE ORPHAN FOAL

If the mare dies, the foal may be raised on cow's milk if care is taken. However, for the first 24 hours the foal should be given the colostrum, if not from its dam then from another "fresh" mare. Keep the following points in mind:

Milk of low fat content from a fresh cow is the best form of cow's milk. Skim milk with cream added in the proportion of 1½ tablespoonfuls per pint may be used.

One tablespoonful of sugar and from 3 to 5 tablespoonfuls of lime water should be added to each pint of milk while the foal is very young.

The milk should be warmed to blood heat before feeding and ½ pint should be given every 2 hours for the first day. After the first day, the time between feedings may be gradually increased to 4 hours, and the total quantity of milk increased. Until the foal begins eating supplementary feeds, 4½ to 6 quarts of milk for each 100 pounds of body weight will probably be required.

Begin feeding grain and hay as soon as possible and keep the foal on pasture as long as grazing is available.

WEANING THE FOAL

In general the foal should be weaned at the age of 6 months and separated from the mare at that time. Having several foals together in the same lot keeps them contented. Although the feeding should be liberal, particularly at weaning time, the quantities of grain and hay to be fed will depend on the pasturage available.

FEEDING THE YOUNG HORSE

The period from weaning time through the third year is most important in the development of the young horse. The foal should be under constant observation in order to keep it growing steadily. Shelter from extreme weather conditions should be provided and a supply of pure water and salt should be available at all times. The diet should consist of a good roughage, either pasture or hay, and a grain mixture which will promote good growth.

Oats and corn are suitable grains for feeding the young horse. Wheat bran, gluten feed, and linseed meal may be used to increase the protein in the diet. The following grain mixtures are satisfactory:

SUGGESTED GRAIN MIXTURES FOR YOUNG HORSES

Mixture No. 1:

Ingredient	*Parts, by weight*
Corn	2
Oats	5
Wheat bran	3
Linseed meal	1

Mixture No. 2:

Ingredient	*Parts, by weight*
Oats	4
Corn	1
Wheat bran	1

It will be necessary to increase the grain allowance as the foal grows. Usually not more than 1 pound of grain per 100 pounds of live weight is required up to the age of 2 years. In addition to the grain the foal needs a liberal supply of roughage. When available, good pasture is best, otherwise a well-cured hay should be fed. Clover, timothy, or alfalfa hay may be

fed. Timothy hay is very popular. Clover and alfalfa hay are relatively high in protein and may be supplemented by roughages of lower protein content such as timothy hay or corn fodder.

FEEDING THE STALLION

Depending on his use for service and the amount of exercise, the stallion should receive about the same quantities of feed as a horse doing moderate work. Plenty of exercise is desirable, preferably in the form of moderate work. By working a stallion regularly, one not only saves the keep of a workhorse that otherwise would be needed, but also saves the trouble of exercising him.

FEEDING MULES

Mules should be given about the same quantities and kinds of feed as horses. There is no conclusive evidence to support the popular assertion that mules require less feed than horses for the same amount of work. However, mules often eat feeds that horses will not touch, and they are much less likely to overeat and founder than horses. Consequently, many farmers allow their mules free access to a feeder filled with corn or other concentrated feed. When mules are shedding their milk teeth at 3 years of age, it is particularly important that they be fed carefully.

FEEDING BEEF CATTLE

Pasture and roughages, preferably the former, should be the foundation of the ration for beef cattle. Corn is the most widely used concentrate for fattening cattle, but it contains too little protein to be used economically without legume hay or some protein-rich concentrate. Silage is an excellent feed for most classes of beef cattle. Very little roughage is wasted when fed as silage.

WATER AND SALT REQUIREMENTS

Care should be taken to insure an adequate supply of clean, pure water for all beef animals. If possible, water should be available at all times; if not, the animals should be watered two or three times daily. Depending on the size of animal, the feed and the climate, 5 to 10 gallons will be consumed daily. In very cold weather, cattle may not drink enough unless the water is warmed for them.

Beef cattle require from ⅓ to 1 ounce of salt per head daily, depending on their feed. It is usually best to keep salt before them at all times.

OTHER MINERALS SOMETIMES NEEDED

Throughout most of the United States, cattle on good pasture or those fed liberally on good legume hay require no other min-

eral than common salt. In regions where the soil is deficient in phosphorus, or when they are pastured on mature dry grass or fed nonleguminous forage most of the year, cattle need from 35 to 50 pounds of phosphate such as bonemeal per head per year.

The cereal grains are deficient chiefly in calcium, which deficiency may be corrected by feeding green leafy legume hay. When it is not possible to feed such a hay, cattle should have access to a mineral mixture of equal parts of salt and finely ground limestone, or other cheap source of calcium.

More detailed information regarding mineral deficiencies and ways to correct them may be found on page 8 under Importance of Mineral Elements.

FEEDING BEEF BREEDING ANIMALS

The breeding herd should be kept on pasture as long as the pasture will maintain the cattle without becoming grazed too closely. Where the pasture is not sufficient, it should be supplemented with soiling crops, silage, hay, or concentrates. The breeding cows may be allowed to lose some weight during the winter season if they are in good condition at the end of the grazing season. Silage and legume hay make a good combination for winter feeding. It is more economical to feed hay from a rack than from an open stack (fig. 4). If legume hay

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FIGURE 4.—A wasteful method of feeding hay from an open stack. The use of a feed rack aids in conserving the feeding value of the hay.

is not available, some protein-rich concentrate, such as cottonseed or linseed meal should be fed.

FEEDING BEEF BULLS

The herd bulls should enter the breeding season in a healthy, vigorous condition. A ratio of 1 to 1½ pounds of a grain mixture of equal parts by measure of corn, bran, and oats to 1 to 1¼ pounds of legume hay per 100 pounds live weight per day is satisfactory. This ration should be fed before and during the breeding season.

FEEDING BEEF CALVES

Young calves on good pasture with plenty of milk from their dams do not usually require any additional feed. However, if they are to be sold when weaned or soon afterwards, they should be fed grain. A good grain mixture for creep-fed calves consists of 3 parts each, by weight, of cracked corn, crushed oats, and wheat bran, and 1 part of linseed meal.

Be sure that the calves are on feeds which keep them growing before they are weaned. If possible, when calves are to be weaned, take them away from their dams abruptly. Keep them where they can neither see nor hear the cow. Keep the troughs clean and do not feed spoiled or moldy feed.

The orphan calf may be fed according to the directions for hand-feeding dairy calves on page 35, or it may be nursed by a cow with good milk production which is nursing a calf about the same age.

FEEDING BEEF BREEDING STOCK

Heifers and young bulls intended for breeding purposes should be kept growing well throughout the entire year, so as to attain full size. If they are stunted while young, the expense of bringing them to maturity may be increased. However, it is not necessary to maintain beef breeding herds on heavy feeds of grain or by continuous full feeding. If they are provided with an ample quantity of good pasturage or an adequate supply of good quality roughage, beef cows and young stock will generally keep in good condition.

FEEDING CATTLE FOR MARKET

Calves that are marketed as fat yearlings should be from well-bred stock of excellent beef type. The calves must be kept growing rapidly. If their dams are not supplying enough milk the calves should be given grain even though they are on good pasture. They should be eating grain readily before

being weaned so they will keep on growing and fattening without interruption. Young cattle require a higher percent of protein and a greater proportion of concentrates in the ration than do older cattle in order to fatten properly.

Spring calves, weaned in the fall, and carried in the feed lot through the winter, should be ready to sell in the following spring without turning out to pasture. Fall calves may be weaned the next spring after the pasture is good. They should be taught to eat grain during the winter and should be continued on a full feed of grain after turning out to pasture. Although they may be finished on pasture and sold early in the fall, it sometimes pays to feed them in a feed lot for 60 to 100 days before marketing. If properly fed, young beef animals should be ready for market at 12 to 18 months of age.

Cheap pasture or other roughage is essential for feeding stockers or other cattle to be held at a maintenance level. Stockers should be kept growing at a rate of 250 to 300 pounds increase per year. Since gains on good pasture are generally more economical than on harvested feeds, it often pays to feed stockers, excepting calves, so that they lose a little in weight during the winter, unless the feed available is unusually cheap. Calves should at least maintain their weight during the winter so that they will continue to grow in size even though they lose a little in condition.

WINTERING BEEF CALVES AND YEARLINGS

Weaned calves may be wintered satisfactorily on 10 pounds of bright-colored legume hay a head daily and yearlings on twice this quantity, but other rations are frequently more economical. However, if yearlings are to be turned out on grass the following summer and a maximum yearly gain is desired, they should be fed so as to gain from 50 to 75 pounds during the winter. The following rations are suggested for wintering 350-pound calves and 600-pound yearlings.

WINTERING RATIONS

For calves:

Ration No. 1:

Ingredient	*Pounds*
Silage	12
Legume hay	5

Ration No. 2:

Ingredient	*Pounds*
Silage	12
Nonlegume hay	4
Protein meal	¾

For yearlings:

Ration No. 1:

Ingredient	*Pounds*
Silage	20
Clover and timothy hay	5
Straw	3

Ration No. 2:

Ingredient	*Pounds*
Legume hay	14
Straw or stover	14

FEEDING STEERS IN A DRY LOT

Mature steers usually fatten in 3 to 4 months of feeding, 2-year-olds in 5 to 6 months, yearlings in 7 to 8 months, and calves in 8 to 10 months. Steers should be started on feed gradually, giving nearly all roughage at first and increasing the concentrates slowly until the steers are on full feed after about 30 to 45 days. Keep them always ready for more feed. Do not overfeed. The efficiency of utilization of feeds for gains in weight decreases as the steer becomes fatter. The proportion of concentrates in the diet should be increased throughout the feeding period. In most sections, the use of a considerable portion of silage increases the economy of the gains during fattening. All laxative feeds should be reduced the last two or three days before shipping cattle and some dry roughage such as timothy or other grass hay should be fed.

The best ration is usually the one which permits the largest gains in weight at the lowest cost. In general, the crops grown locally or on the home farm are the most economical to use in the ration. The proportion of concentrate to roughage, the kind of protein supplement to use to balance the corn or other fattening feed, and other problems depend for their solution on the availability and the relative price of the different feeds. The following rations are suggested for fattening 2-year-old steers of approximately 1,000 pounds live weight.

Ration No. 1:

Ingredient	*Pounds*
Corn	20
Legume hay	8

Ration No. 2:

Ingredient	*Pounds*
Corn	20
Cottonseed meal	2
Mixed hay	5

Ration No. 3:

Ingredient	*Pounds*
Cottonseed meal	4
Corn silage	40
Straw or stover	5

Ration No. 4:

Ingredient	*Pounds*
Corn	14
Linseed meal	2
Mixed hay	5
Corn silage	25

In general, cottonseed meal and linseed meal may be substituted for each other, pound for pound, depending on which is the cheaper.

When fattening cattle are being fed corn, corn silage, and other feeds with whole grains, hogs should follow them to consume the undigested grain. At least one 100-pound hog should be provided for each 1,000-pound steer.

FEEDING STEERS ON PASTURE

Whenever possible, pasture should be the foundation for feeding steers, since gains made on pasture are usually the cheapest. It often pays to supplement pasture with grain in order to produce the desired grade of slaughter cattle in a reasonable time. The problem that often faces the feeder when finishing cattle on grass is whether to feed a supplement for a part of the grazing period or for the entire pasture season. The method to follow will depend somewhat on how the cattle were fed during the previous winter and the quantity and quality of pasture available. If the cattle were well wintered and fed considerable grain, it may be desirable to feed a supplement throughout the grazing period. If they were carried through the winter on silage and dry roughage with a little meal or cake and there is an abundance of grass of good quality, it may be just as satisfactory to feed a heavier grain supplement only for the last half of the season.

Corn alone is the supplement most extensively used for fattening steers on grass. It may be replaced by corn-and-cob meal, ground barley, or in part by any cereal grain. Bluegrass is the principal pasture grass for fattening steers in the Middle West and Appalachian region whereas bluestem, buffalo, wheat and grama grasses are highly satisfactory in the Great Plains. Steers should either be marketed off pasture before they begin to lose weight in late summer or finished in the dry lot if pastures fail.

FEEDING DAIRY CATTLE

GENERAL CONSIDERATIONS

In general, the points mentioned for the feeding of beef cattle will hold in the feeding of dairy cattle, except cows producing milk. For the successful feeding of dairy cattle, the feeds used should be of good quality, abundant in quantity and low in price. The foundation of the dairy ration should be a plentiful supply of roughage that is palatable and of good quality, either pasturage or hay and silage. These roughages should be supplemented, when necessary, by concentrates containing a sufficient percent of protein.

All grains should be ground or crushed before being fed to dairy cattle. It does not pay to grind hay for dairy cattle, but chopping coarse, fibrous hays, fodder or stover will result in an increased consumption of the coarse parts.

Dairy cattle should have ready access to salt at all times. This is especially true of cows producing milk. Salt may be mixed in the concentrate ration at the rate of 1 part for each

100 pounds of grain, but high-producing cows should be allowed additional salt.

Cattle on good pasture or fed hay of good quality usually will receive an adequate supply of mineral elements. In the case of cows producing a large quantity of milk, it may be desirable to feed additional calcium or phosphorous in such a form as bonemeal. In regions where iodine is deficient it may be desirable to provide that element as directed on page 9.

The water supply for cows in production is especially important. Large quantities of water are required for the secretion of milk and must be provided. While the amount varies through a wide range, a consumption of 15 to 25 gallons is considered as average. Cows should have water available at all times or be allowed to drink at least twice a day, more frequently in warm weather. If the water is too cold, dairy cows may not drink enough and so the water should be warmed or the cows should be allowed to drink more often. If individual watering cups are used in the stable, they should be of such type that they may be easily kept clean to prevent contamination of the water.

FEEDING THE DAIRY COW

The dairy cow should be given enough feed during the period of milk production and while dry so that she is maintained in good flesh and in a healthy, thrifty condition, but not so she will become too fat. The optimum dry period is about 8 weeks.

The most favorable conditions for the production of milk are provided by pasturing the herd on young succulent grasses and legumes. During the spring or early summer, for a period of a month or so a permanent pasture may supply all the feed a cow will need even for rather heavy milk production. In most localities, however, climatic conditions and the growth habits of the pasture plants usually result in a pronounced decrease later in the pasture season in the quantity and value of the feed which may be obtained by the animals. It is usually necessary, therefore, in the late summer and early fall to provide some other roughage, to feed more of a concentrate mixture, or to do both. A suplementary pasture of such crops as lespedeza, Sudan grass, millet, sweetclover, or alfalfa will often solve this problem.

Turning the cattle on the aftermath which grows up after hay has been harvested is one of the most economical means of furnishing additional feed late in the pasture season. Another means of maintaining milk production at this time of the year is by feeding corn or other soiling crops. As there is no practical way of determining how much pasturage a cow eats, the supplementary feed she requires must necessarily be estimated. The feeder should observe the condition of the cows and note whether the milk flow is being maintained satisfactorily.

If the cows lose much flesh or decline rapidly in milk flow they need more feed.

WINTER FEEDING

The most economical basis of the diet for winter feeding of the dairy cow is a liberal quantity of a good, palatable legume hay, preferably alfalfa, together with corn silage. The more the cows will eat of such roughage, the less they will need of

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FIGURE 5.—Feeding dairy cows according to production. Note the scales attached to feed truck for convenience in weighing feed.

the expensive concentrates. Legume hays especially are valuable because of their high content of proteins and mineral elements. Silage is of value because of its carbohydrate and carotene content and because cows will consume more nutrients in the form of silage and hay than in the form of hay alone unless the hay is of high quality. Sometimes it is desirable or necessary for the farmer to make all his hay crop into silage in order to save it in a form suited for yielding the greatest value to dairy cows. Under such conditions the silage can replace a large part of the hay allowance in the ration. Cows will eat from 2½ to 3 pounds of hay silage for every pound of hay ordinarily fed.

Dry cows and low producers may be carried through the winter on good hay or hay and silage alone, but high-producing cows

will not maintain their production unless they are given enough concentrated feed in addition. For best results the weight of the milk produced should be determined and all feeds should be weighed (fig. 5).

THE CONCENTRATE ALLOWANCE

Every cow should be fed concentrates according to her needs. It is wasteful of feed to give each cow the same quantity regardless of her production. Low producers will be fed more concentrates than they will pay for, and cows that are inherently high producers will fail to give as much milk as they are capable of giving—they will become thin and will slump in milk production. All cows fed home-grown forages should have at all times all the pasture grass, hay, or silage, or all of these feeds that they can eat. Certain cows at certain times may need no other feed, but usually most cows will require some concentrates to maintain their production of milk.

The quantity of the concentrate allowance depends on the quantity of forage eaten, the amount and richness of the milk produced, and the relative prices of concentrates and milk. The heavier the feeding of concentrates the greater will be the production of milk, but as the feeding of concentrates is pushed to higher levels the returns for each increase in concentrates becomes less and less so that it usually does not pay to feed cows to the limit on concentrates. However, it usually pays to feed the moderate amounts of concentrates specified in table 3. (See p. 71.) Some increase in these amounts should be made if concentrates are low in price as compared with the price of milk (if the value of concentrates is less than 75 percent of the value of an equal weight of milk). If hay is expensive, if the cows tend to become thin, or if they are declining unduly fast in milk production, it will pay to feed more concentrates.

Any increases in concentrates should be made gradually, usually not faster than 1 pound every other day. After a cow freshens, take 2 to 4 weeks to get her on full feed. If a cow fails to eat within 30 minutes all of the concentrates given her, remove the refused concentrates from the manger at once and give her less at the next feeding.

THE PROTEIN CONTENT OF THE CONCENTRATES

The more protein the dairy cow receives in the forage allowance the less protein is needed in the concentrates. For example, if a cow is on good pasture or if she eats 1⅓ pounds or more a day of good legume hay for each 100 pounds live

weight (a 900-pound cow 12 pounds, a 1,200-pound cow 16 pounds) the concentrates need not contain more than 12 percent total protein. Cows producing very heavily, or more than about 1½ pounds butterfat a day, will require either more legume hay or more protein in the concentrates. If a dairy farmer has good pasture in the summer and if he feeds plenty of good legume hay in the winter his cows will need no more protein than will be supplied in his farm grains.

Mixed hay has less protein than legume hay alone. More protein is needed in the concentrates that are fed with this kind of hay—16 percent instead of 12 percent.

With straight grass hay, silage, or fodder the protein content of concentrates should be 18 percent or in normal times even more.

The following grain and concentrate mixtures will provide 12, 16, or 18 percent protein, for use in supplementing the various kinds of roughage:

12 percent protein

Oats.
Barley.
Oats and barley, equal parts.
Corn, oats, and wheat bran, equal parts.
Corn, oats, barley, and wheat bran, equal parts.
Corn 70 parts, oats 20, oil seed meal (soybean, linseed, etc.) 10.

16 percent protein

Wheat bran.
Wheat bran and middlings (mill run).
50 parts corn, 30 oats, 20 soybean meal or cottonseed meal.
40 parts corn, 25 oats, 20 bran, 15 soybean meal or cottonseed meal.
50 parts corn, 35 bran, 15 soybean meal or cottonseed meal.
50 parts barley, 30 oats, 20 linseed meal.

18 percent protein

50 parts oats, 30 bran, 20 linseed meal.
40 parts corn, 40 bran, 20 soybean meal or cottonseed meal.
40 parts corn, 35 oats, 25 soybean meal or cottonseed meal.
30 parts corn, 25 barley, 25 bran, 20 soybean meal or cottonseed meal.

FEEDING CALVES AND YOUNG STOCK

The new-born calf should be given its dam's first milk, or colostrum, until the milk is fit for human use. This milk is some-

what laxative, helps to clear out the calf's digestive tract, and helps to protect the calf against infection.

If the calf is to be raised by hand it should be separated from the cow and kept in clean, dry quarters, which are well ventilated but free from drafts, and not too cold. Keep all utensils used in feeding the calf clean by washing thoroughly after each feeding.

It is best to feed too little milk rather than too much, since the digestive system of the young calf is easily upset. For the first few days feed fresh warm milk 2 or 3 times a day, allowing 5 to 8 pounds daily, depending on the size of the calf. A 50-pound calf should be given 5 pounds and an 80-pound calf 8 pounds. Larger calves should receive slightly more milk. If the calf is digesting the milk properly, the daily allowance may be increased 1 to 2 pounds during the second week. The calf should be fed at regular hours. The proper temperature of the milk is between 90° and 100° F., and the quantity fed should be weighed.

If the calf is growing well, skim milk may be gradually substituted for whole milk after the second or third week. At least 10 days should be taken to make the change. If the manure becomes liquid or pasty, a condition known as diarrhea or scours, the milk is not being digested properly. If this occurs, stop any further substitution of skim milk until the condition disappears. The skim milk should be fed warm. Increase the daily supply of skim milk by 2 pounds every week until the calf is getting 12 to 16 pounds. Continue the skim milk to 6 months if a cheap supply is available.

If skim milk is not available, the calf may be raised on other feeds, such as fresh buttermilk, fresh whey, dried skim milk, dried buttermilk, semi-solid buttermilk, and special calf meals. Suitable feeding methods with such substitutes are given in Farmers' Bulletin 1723.

When the calf is 2 or 3 weeks old, drinking water should be provided and the calf started on hay and grain. Start with a small quantity of good green hay and a handful of whole or coarsely ground corn or oats. A little wheat bran or linseed meal should be added to the grain unless a legume hay is fed. The quantity of grain fed should be about ½ pound daily at 4 weeks of age, 1 pound at 6 weeks, 1½ pounds at 8 weeks, and 2 pounds at 10 weeks. From the age at which the calf will eat 3 pounds of grain a day to the end of the first year this allowance of grain will be enough to bring about good growth provided it is fed along with plenty of good hay or hay and silage (fig. 6).

From 1 to 2 years of age the heifers may be fed exclusively on pasturage in the summer and good hay and silage in the winter, or they may be fed grain in addition. If they are to be large enough to freshen at 2 years of age they will ordinarily need 3 or 4 pounds of grain a day during the second year. However, there is no objection to lighter feeding if she is bred to freshen at an older age. In any event the heifers at calving time should not only be of good size but should also be in a good state of flesh.

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FIGURE 6.—Feeding grain to calves in home-made stanchions.

FEEDING THE DAIRY BULL

Bulls should be fed enough to keep them in a medium state of flesh, but not fat. They should be fed a good quality roughage. A light feeding of corn or hay silage is recommended as a good source of carotene. In addition they should receive from 5 to 10 pounds of concentrates daily depending on their condition and the service required of them.

The best way to keep a bull in summer is in a small pasture. The feed from that source is good for him and the exercise obtained tends to keep him in good condition. On pasture the bull should receive enough concentrates to maintain him in medium flesh.

FEEDING HOGS

Corn is probably the feed most commonly used in feeding hogs, but corn alone will not furnish enough protein, vitamins, or minerals. It should be supplemented by other feeds such as tankage, fish meal, wheat middlings or shorts, linseed meal, soybeans, skim milk, buttermilk, good pasturage, or leafy-green legume hay. If such feeds as barley, wheat, rye, sorghum, peanuts, and sweetpotatoes are fed, the proper supplementary feeds should be provided. To avoid the production of "soft pork," the feeding of peanuts and soybeans must be restricted.

Good pasture for growing pigs, brood sows, and other classes of hogs often means the difference between a profit and loss in hog raising.

FEEDING GARBAGE TO HOGS

When properly managed, the feeding of garbage to hogs is a practical method of pork production. The garbage should be collected frequently and be free from all injurious articles. Frozen garbage should be thawed before feeding. Raw garbage is readily eaten by hogs, but there is danger of infestation with trichinae, unless the garbage containing bones and meat scraps is kept separate and thoroughly cooked before being fed to hogs.

Hogs should be immunized against cholera before feeding on garbage for there is a possibility of acquiring that disease from raw pork which may be present.

MINERALS FOR HOGS

A diet containing corn or other cereal grains, supplemented with such feeds as skim milk, tankage, or fish meal, usually furnishes enough calcium and phosphorus to meet the mineral requirements of the pig. However, it is common practice to supply a mineral mixture in a box or self-feeder so that the pig may have access to the mineral elements which may be lacking in the diet. Many combinations have been suggested for supplying the salt, calcium, and phosphorus deficiencies in the feed of hogs. A mixture of equal parts by weight of common salt, steamed bonemeal, and ground limestone or air slaked lime is palatable and contains the minerals needed for supplementing grains. This mixture may be fed to pigs on pasture or in the

dry lot. In sections where there is danger of goiter, it is advisable to substitute commercial iodized salt for the regular salt or to add potassium iodide at the rate of an ounce to each 300 pounds of salt.

WATER FOR HOGS

Many hog feeders make the mistake of not providing enough water for hogs. The requirement is from 2 to 6 quarts of water daily per 100 pounds live weight. In cold weather it may be necessary to warm the water so the animals will drink enough. If the ration contains milk, or is fed as a slop, less water is required, but a supply should be available at all times.

SELF-FEEDERS

Self-feeders are valuable in feeding hogs. Their use tends to save feed and labor and to produce more rapid gains. The grain and protein supplement may be mixed together or they may be fed in separate compartments of the feeder, allowing

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FIGURE 7.—An economical self-feeder that protects the feed from rain and can be regulated to reduce waste.

the pig to choose for itself. Experiments show that the pig usually balances its diet properly, eating relatively less of the high-protein feeds as it gains in weight. Self-feeders are sometimes used for sows which are suckling their pigs, but not ordinarily for breeding stock (fig. 7).

FEEDING BROOD SOWS

Feeding during pregnancy should be liberal but not so liberal as when pigs are being nursed. An overfat sow may produce pigs which are low in vitality, and she may be more clumsy with

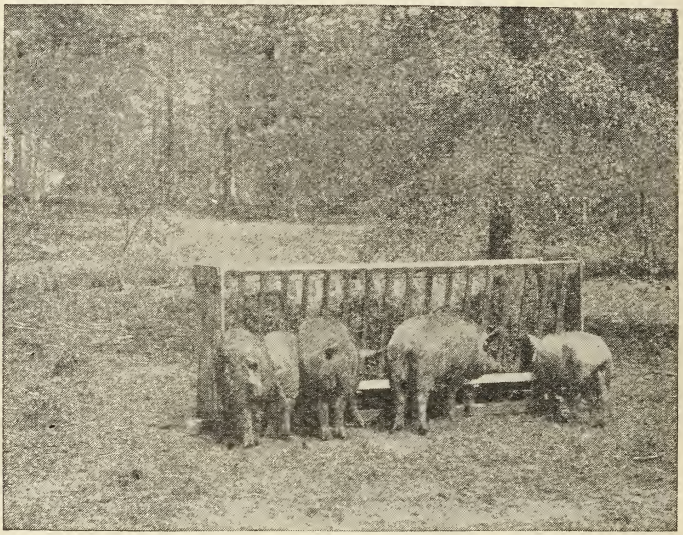

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FIGURE 8.—Alfalfa hay fed to brood sows adds bulk to the ration and is an excellent protein supplement.

them. On the other hand, a sow that is too thin cannot nurse a litter of pigs properly.

During pregnancy, sows should receive feeds which contain plenty of protein, minerals, and vitamins. Alfalfa hay fed in a rack (fig. 8) is an excellent means of providing a legume supplement for sows not on good pasture. Sows should be provided comfortable quarters with room for exercise, and should be kept free of lice. Plenty of water should be available.

The sow's ration should be fed dry and it is advisable toward the end of gestation to feed a small quantity of linseed meal if she shows signs of constipation. Root crops may be fed as a supplement in the diet of sows during the winter months. They are succulent and laxative, but, because of their high water content, their relative feeding value is low. The feeding of coarse, bulky, laxative feeds, such as bran and linseed meal, just before farrowing, together with plenty of exercise, will prevent any tendency for the sow to eat her young.

For 3 or 4 days preceding farrowing, the feed of the sow should be slightly reduced. After farrowing, she should have no feed for the first 24 hours, but should be liberally supplied with warm water. The first feed should be a thin slop of bran and middlings. For the next 3 or 4 days the feed should be light and the sow should not be on full feed for a week or 10 days.

If the pigs begin to scour, reduce the sow's feed and give a small quantity of oats. Place a piece of rock lime slightly smaller than a baseball in a gallon of water, drain the water off the slaked lime and give it to the sow to drink. Bathe the sows's udder and teats with the lime water. In addition, give the pigs (on the tongue) 5 drops of formalin solution prepared by mixing 1 ounce of standard-strength formalin and 1 pint of water. The sow's teats may be washed once or twice daily with a solution prepared by adding 1 ounce of the prepared formalin solution to a pint of water.

After 2 or 3 weeks, sows and pigs will adjust their own diet satisfactorily if they are supplied the proper assortment of feeds in a self-feeder.

FEEDING THE YOUNG PIGS

Pigs confined indoors or in pens with paved floors, without access to the soil may suffer with anemia. To prevent this condition about 50 pounds of clean sod or soil containing 10 grams of ferrous sulfate and 1.5 grams of copper sulfate may be provided. The copper and iron compounds are dissolved in a pint of hot water and the solution sprinkled over the soil. Anemia may be prevented also by giving each pig ⅓ teaspoonful of saturated ferrous sulfate solution once or twice during the first week and increasing the dose to 1 teaspoonful in the third or fourth week. It is best to continue this treatment till the pigs are 6 weeks old.

A self-feeder (fig. 9) containing shelled corn should be available for the pigs when they are about 3 weeks old. When the pigs reach the age of 5 or 6 weeks, wheat middlings, tank-

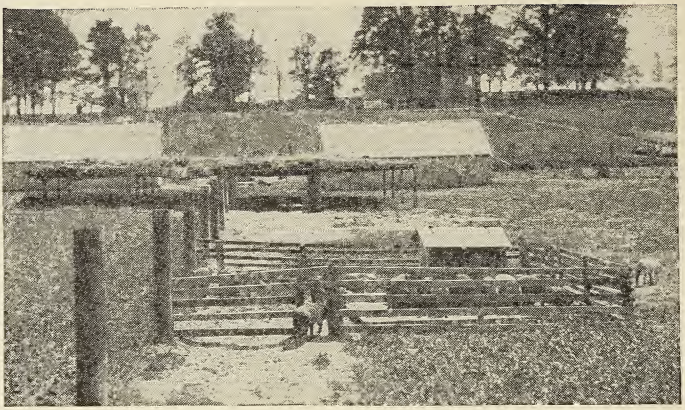

FIGURE 9.—Pigs eating from self-feeder placed inside creep. Artificial shade (in background) is necessary if natural shade is not available.

age, fish meal, soybean meal, or peanut meal should be supplied in a separate compartment of the feeder. The pigs will grow faster and be more thirfty if they have access to a good pasture.

HAND-FEEDING NEW-BORN PIGS

If at all possible pigs should obtain the colostrum or first milk of the sow. If the sow fails to produce enough milk to supply the pigs, some or all of them may be fed cow's milk in small quantities at 2-hour intervals. If milk is not available, a mixture of 2 ounces of dried whole milk with 8 ounces of water may be fed. The milk should be warmed to body temperature for feeding. It may be fed from bottles with nipples, or the pigs taught to drink from a shallow pan. The feeding utensils must be kept clean and the milk used must be fresh.

WEANING THE YOUNG PIGS

The pigs should be weaned at 8 to 12 weeks of age, depending on the condition of the pigs and sow and whether the sow is to raise 1 or 2 litters a year. It is important that the pigs be eating grain before weaning. Four or five days before that time the sow's feed should be cut at least one-half. Do not change the diet of the pigs when weaning, except to add a

limited quantity of skim milk if available. An abrupt change in diet should be avoided. Good pasture is the best substitute for milk at the time the pigs are weaned.

FEEDING YOUNG PIGS KEPT FOR BREEDING

Pigs to be kept for breeding purposes should be well fed to provide for good growth and development of bone and muscle, but they should not be allowed to become fat. After young gilts are bred, they should receive enough feed to produce their litters and finish their own growth properly.

FEEDING FATTENING PIGS

The feeding of pigs for market may be divided into two periods: the growing period from the time of weaning to about 8 or 10 weeks before marketing and the fattening period.

During the growing period, the pigs should be fed in much the same way as those intended for breeding purposes. They should be given about 50 percent more grain than the breeders, and plenty of pasture should be available. The daily grain allowance, with pasture, should usually be about 3 percent of the body weight of the animal.

During the fattening period more grain and less of the protein concentrates are used for producing fat. A good concentrate mixture for pigs on green pasture is 20 parts by weight of corn to 1 part each of tankage and soybean meal. Changes in the diet should be slow and the feed should not be increased too rapidly, or the pigs may go off feed. Pastures of crops, such as alfalfa and clover, are excellent for keeping the pigs' appetite keen. Pigs may be successfully carried from weaning time to marketing by supplying corn, protein concentrates, and minerals in separate compartments of a self-feeder.

Formulas for mixed feeds for self-feeding hogs in dry lot are as follows:

WEANING TO 100 POUNDS WEIGHT

Ingredient	*Pounds*
Ground corn	70.0
Tankage or fish meal	6.0
Linseed oil meal	6.0
Soybean oil meal	7.5
Middlings	3.5
Alfalfa leaf meal	6.0
Mineral mixture	1.0
Total	100.0

Ingredient	*Pounds*
Corn	64.0
Oats	20.0
Tankage or fish meal	5.0
Alfalfa leaf meal	5.0
Soybean oil meal	5.0
Mineral mixture	1.0
Total	100.0

100 POUNDS WEIGHT TO APPROXIMATELY 225 POUNDS WEIGHT

Ingredient	*Pounds*	*Ingredient*	*Pounds*
Ground corn	81.0	Corn	20.0
Tankage or fish meal	2.0	Barley	46.5
Linseed oil meal	4.0	Wheat	20.0
Soybean oil meal	7.0	Soybean oil meal	8.0
Alfalfa leaf meal	5.0	Alfalfa leaf meal	4.0
Mineral mixture	1.0	Mineral mixture	1.5
Total	100.0	Total	100.0

Separate compartments of the feeder are often used for the grains and the protein and mineral mixture thus allowing the hogs to balance their own ration, free choice.

SUGGESTED FORMULAS FOR PROTEIN-MINERAL MIXTURES

	Formula No.—				
	1	*2*	*3*	*4*	*5*
Ingredient	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Tankage	20	10	10	10	--
Fish meal	--	10	--	10	--
Linseed oil meal	25	--	20	--	25
Alfalfa leaf meal	25	25	--	25	25
Cottonseed meal	--	25	20	--	--
Soybean oil meal	25	25	--	50	50
Peanut oil meal	--	--	45	--	--
Mineral mixture [1]	5	5	5	5	5

[1] Mineral mixture may be composed of: 57.9 parts by weight of ground limestone, 20 parts steamed bonemeal, 20 parts iodized salt, 2 parts ferrous sulfate and 0.1 part copper sulfate.

Skim milk or buttermilk may be substituted for fish meal or tankage. Approximately 11 pounds of skim milk will replace 1 pound of tankage. Fish meal and tankage have practically the same feeding value, and may be substituted pound for pound. Linseed oil meal, soybean oil meal, peanut oil meal, or cottonseed meal may be used interchangeably in the protein part of the ration. Hogs that have access to good-quality legume crops or rape will require approximately half as much protein concentrates as pigs fed in dry lot.

FEEDING THE BOAR

The boar should be given plenty of protein-rich feeds during the breeding season. He should have the run of a quarter acre

or more of pasture, or have access to a rack containing leafy legume hay in his paddock.

FEEDING SHEEP

Gentle handling, regular feeding, and quiet are especially important in the feeding and management of sheep. The flock in summer needs good pasture, shade, salt, and plenty of pure water. Salt should be kept before sheep at all times. They will take too much if given salt only at intervals. Sheep frequently suffer from lack of water. They need from 1 to 6 quarts per head daily, depending on the feed received, weather conditions, and the water content of the forage.

FIGURE 10.—Sheep being pastured on standing corn, a method of feeding which saves labor for the flock owner.

The practice of harvesting corn with fattening lambs or sheep is a good one (fig. 10). Some crop such as soybeans or rape should be grown in the corn.

PREVENTION OF STOMACH-WORM INJURY

When sheep graze on pastures which are limited in range there is danger of serious stomach-worm infestation. This is especially true of young lambs which are more susceptible than older animals. If possible, pastures should be divided and the flock rotated from one division to another about every 2 weeks.

Thus by continually providing the flock with new pasture, losses from stomach-worm infestation may be reduced.

Stomach worms may be removed by drenching the sheep at regular intervals (every 15 to 30 days) throughout the pasture season with a 1 percent solution of copper sulfate. This solution is poisonous and sheep should be dosed with care. The usual dose for the average ewe is 3 to 4 ounces. Lambs (after weaning) should be given less. Another treatment is the use of phenothiazine in doses of 25 grams to sheep and 15 grams to lambs as a drench or in capsules, or fed free choice in a mixture of 1 part of phenothiazine and 9 parts of salt. For more complete directions see Farmers' Bulletin 1330.

FEEDING THE BREEDING EWES

Before the breeding season in the fall all nonbreeding, poor-milking ewes should be discarded from the flock. At the time the ewes are bred they should be gaining in weight. Placing the ewes on abundant pasture or adding a grain supplement 2 or 3 weeks before breeding—a practice called "flushing"—tends to increase the proportion of twin lambs and to have the lambs born near the same time.

Stubble and stalk fields, fence strips in plowed fields, late pastures, pasturage on green rye, and velvetbeans (in the South) will help carry the breeding flock through the fall and well into the winter. Legume hays and straw are usually desirable for economical winter feeding. Silage and root crops also are good feeds for wintering, if they are supplemented with a protein-rich concentrate. Timothy hay that is cut when too ripe is not good feed for sheep.

Heavy grain feeding just before lambing may cause udder trouble. After lambing, ewes should be fed lightly at first, being put on full feed after the third or fourth day depending upon the quantity of milk needed for the lambs.

RATIONS FOR BREEDING EWES

Each of the following rations contains approximately the quantity of the various nutrients required daily for ewes of 110 to 140 pounds in weight:

Ration No. 1:

Ingredient	*Pounds*
Alfalfa or soybean hay	3
Corn silage	2
Shelled corn	½

Ration No. 2:

Ingredient	*Pounds*
Alfalfa	3
Corn stover	2

Ration No. 3:

Ingredient	*Pounds*
Alfalfa	3½
Silage	2

Ration No. 4:

Ingredient	*Pounds*
Oat straw	2
Corn silage	2
Linseed meal	¼
Shelled corn	¾

ORPHAN LAMBS

If a ewe dies at lambing, its lamb should be nursed, if possible, by another ewe which has recently lambed. If this cannot be done, the lamb should be given the colostrum milk from another ewe for at least 2 days. Feed 1 ounce every two hours, using a bottle with a nipple. On the third day milk from a cow or goat may be substituted. If cow's milk is used, it should be high in butterfat. For the remainder of the first week, the intervals between feeding may be gradually increased to 4 hours and the quantity fed increased to 2 ounces per feeding. During the second and third weeks, gradually increase the quantity per feeding to 6 ounces. At this time the lambs should be started on grain and hay. The daily feedings of milk may be reduced to 3 and the quantity increased to 1 pint at each feeding. All bottles used in feeding should be sterilized, the milk should be clean and fresh and fed at approximately 100° F.

FEEDING THE LAMBS

Well-nourished lambs from well-fed ewes have few troubles, but the following points will help in clearing up difficulties that sometimes arise.

Constipation is remedied by a teaspoonful of castor oil.

If lambs are sold at 3 to 5 months of age, they may run with their dams until that time. Those lambs kept for breeding purposes should be weaned at from 4 to 5 months of age and put on fresh pasture where there is no danger of stomach worms.

At 10 to 16 days of age the lambs should have access to a creep where they may get hay in a rack and grain in a trough arranged so they cannot get their feet in the feed. Green alfalfa is one of the most relished feeds. Flaky wheat bran is good also.

Until the lambs are 5 to 6 weeks old their concentrate feed should be coarsely ground or crushed. Cleanliness is important in keeping the lambs growing. Always feed in a clean trough.

WEANING THE LAMBS

The best method of weaning is to leave the lambs on the old pasture for 3 or 4 days and remove the ewes to a scanty pasture to check the milk flow.

RAISING LAMBS IN THE DRY LOT

Some breeders raise lambs in a dry lot in order to avoid stomach-worm injury. The lambs do not leave the sheds and yards until they are weaned, when they are put on clean fresh pastures. In the meantime they are fed hay and grain, and their dams are returned from the pasture two or three times daily to allow the lambs to nurse. A few breeders keep both lambs and ewes in the dry lot, feeding soiling crops to the ewes to keep up the supply of milk.

RAISING LAMBS ON FORAGE CROPS

The practice of grazing the flock on forage crops (fig. 11) until the lambs are sold is becoming increasingly popular where land is high in price and where stomach worms cause trouble. The lambs and ewes are allowed to graze on fall-sown wheat or rye. The land is divided so the flock is not kept on the

FIGURE 11.—Lambs pasturing on soybeans.

same ground more than 10 or 14 days. By the time the second lot of this crop is grazed down, spring-grown peas and oats can be ready, and the fall-wheat land plowed and sowed to another cereal or to rape or soybeans, for later use. This plan produces more feed per acre, but requires more labor and fencing.

FATTENING LAMBS

In fattening home-grown or purchased feeder lambs, it is good practice to start them on pasture, such as stubble fields, the aftergrowth of hay fields, or any other forage available. The lambs may be carried on such feed for a month or two, meanwhile, gradually being accustomed to grain. The usual fattening period is 90 to 100 days and the lambs should gain 30 or 40 pounds per head during that time.

Precautions should be taken in starting the lambs on grain for there is danger of their overeating. They should have a fill of good roughage and then be allowed about one-tenth pound of grain per head. After about 6 weeks the lambs should be eating 1 pound of grain per head daily together with about 2 pounds of hay or roughage. Toward the end of the fattening period, the diet should contain approximately equal portions of grain and roughage.

DIETS FOR FATTENING LAMBS

Corn with alfalfa or clover hay is an excellent combination for fattening. Coarser hays such as soybean hay may be used. If good legume hay is not available, other hays may be used, but the diet must be supplemented with a protein concentrate, such as cottonseed, linseed, or soybean meal. A mixture of 1 part of the protein concentrate with 7 parts of corn or similar feed is satisfactory. Other feeds, such as corn silage, roots, tubers, screenings, and molasses may be used in fattening lambs. Silage must not be frozen, moldy, or excessively acid. A dry roughage, preferably legume hay, should be fed with corn silage. The grain need not be ground for lambs after the first few weeks.

The consumption of grain and the rate of gain is appreciably greater with self-feeding than with hand-feeding. The grain consumed per pound of gain in weight is apt to be greater if the lambs eat from self-feeders. For this reason, it is best to mix some bulky material such as chopped alfalfa in the proportion of 1 part to 3 or 4 parts of concentrate mixture.

FEEDING RAMS

Beginning a month before the breeding season, rams should be given some extra grain. Two parts of oats and one of bran,

by bulk, is a good mixture. Oats alone are good also. If the ram is thin, feed a mixture of 5 parts by weight of corn, 10 parts of oats, 3 parts of bran, and 2 parts of linseed meal. Rams should be fed about the same quantity per 100 pounds' weight as ewes.

FEEDING MILK GOATS

Milk goats should have about the same kind of feeds as dairy cows. A successful winter ration for goats in milk is 2 pounds of alfalfa or clover hay, 1½ pounds of silage or turnips, and 1 to 2 pounds of grain. The grain mixture is composed of 100 pounds of corn, 100 pounds of oats, 50 pounds of wheat bran, and 10 pounds of linseed meal. When the goats are on good pasture, they may be given 1 or 1½ pounds of the above grain mixture with the linseed meal omitted.

FEEDING ANGORA GOATS

Most of the feed of Angora goats on range is browse, weeds, and grass. Evergreen brush (not cedar or other coniferous vegetation) is relied on for winter feed. While sheep and goats do not thrive on pine needles, they may eat the buds and do considerable damage to the young trees. When supplementary feeds are necessary, the hays, kale, rape, milo, feterita, oats, and similar feeds suitable for sheep may be used for goats.

FEEDING POULTRY

GENERAL PRINCIPLES FOR FEEDING POULTRY

Well-balanced, palatable diets must be fed, if good results are to be obtained in feeding chickens. With good stock, the additional cost of a good diet is repaid many times in better growth, improved health, and greater egg production. Some general points to be kept in mind in feeding chickens are:

A diet is not well balanced unless it supplies enough of the right kind of protein, vitamins, and minerals for the purpose for which it is being fed.

The kind and quantity of the proteins in the diet determine, to a large extent, both the rate of growth and the rate of egg production.

Alfalfa leaf meal or alfalfa meal of good quality should be included in the diet, if green feed is not fed.

Give the birds skim milk or buttermilk to drink, whenever available.

A source of vitamin D such as fish oil or irradiated animal sterol should be mixed with the feed if the birds are confined or are not exposed to plenty of sunshine.

When well-balanced diets are used it is economical to keep the feed before the chickens at all times. All the feed, both the mash and the grain mixture should be fed in hoppers (fig. 12). The feeding of grain in the litter is insanitary. Self-feeders save labor in feeding poultry and may be used in feeding dry mash or grain.

FIGURE 12.—Equipment suitable for feeding mash and grain. It is insanitary to feed grain in the litter.

Grit is of value in feeding poultry. If the birds do not have access to the soil, grit should be supplied in suitable boxes or hoppers. River gravel or native pebbles are excellent for this purpose.

Limestone or oystershell are often made available in hoppers in order to supply calcium to chickens. However, the diets given in this handbook contain the correct quantities of calcium and the consumption of any further calcium would throw the diet out of balance.

MASH AND GRAIN DIETS FOR LAYING HENS

DIET NO. 1

MASH

Ingredient	*Parts by weight*
Finely ground oats	10.0
Wheat middlings	15.0
Ground yellow corn	16.0
Soybean oil meal	32.0
Alfalfa leaf meal	8.0
Riboflavin supplement [1]	5.0
Steamed bonemeal	5.5
Ground limestone [2]	6.5
Manganized salt [3]	1.0
Iodized salt [4]	.4
Vitamin-A-and-D feeding oil [5]	.6
Total	100.0

GRAIN MIXTURE

Ingredient	*Parts by weight*
Whole yellow corn	50
Wheat	50
Total	100

DIET NO. 2

MASH

Ingredient	*Parts by weight*
Ground yellow corn	16.5
Ground wheat	15.0
Finely ground oats	15.0
Soybean oil meal	25.0
Meat scrap	5.0
Alfalfa leaf meal	8.0
Riboflavin supplement [1]	2.5
Ground limestone [2]	6.0
Steamed bonemeal	5.0
Manganized salt [3]	1.0
Iodized salt [4]	.4
Vitamin-A-and-D feeding oil [5]	.6
Total	100.0

GRAIN MIXTURE

Ingredient	*Parts by weight*
Whole yellow corn	50
Oats	25
Wheat	25
Total	100

[1] May be dried whey, dried distillers' solubles, or other byproduct containing at least 15,000 micrograms of riboflavin per pound. Supplements containing more riboflavin may be used at proportionately lower levels.

[2] Neither oyster shell nor limestone grit should be fed with either of these diets, as they supply all the calcium needed.

[3] A mixture of 100 parts common salt and 5 parts of technical anhydrous manganous sulfate.

[4] The standard commercial product is recommended. If this is not available, ordinary salt may be used.

[5] Should contain 400 A. O. A. C. units of vitamin D and at least 2,000 International Units of vitamin A per gram.

Plenty of clean fresh water should always be available to chickens. A flock of 50 laying hens requires about 15 quarts of water a day, preferably in a clean, shallow pan.

FEEDING HENS FOR EGG PRODUCTION

The mash and grain diets on the preceding page are balanced according to the best information available on the nutritive requirements of hens. Approximately equal quantities of the mash and grain mixtures should be provided. Either grain mixture may be used with either mash.

FEEDING THE BREEDING FLOCK

More attention should be given to the feeding of the breeding flock than of hens kept for market-egg production.

All-mash diets give more uniform results in the feeding of the breeding flock than do the mash-grain diets. However, the mash-grain diet No. 2 previously listed will be found quite satisfactory for the production of hatching eggs if the meat scrap is replaced by fish meal and the level of riboflavin supplement is doubled.

See that males as well as the hens get plenty of feed. The following all-mash diet is a good one for the breeding flock:

ALL-MASH DIET FOR THE BREEDING FLOCK

Ingredients	DIET NO. 1 *Parts by weight*	DIET NO. 2 *Parts by weight*
Ground yellow corn	20.0	28.0
Ground wheat	29.0	20.0
Finely ground oats	10.0	10.0
Wheat middlings	15.0	----
Wheat bran	-----	12.0
Soybean oil meal	7.0	12.0
Fish meal	3.0	3.0
Meat scrap	1.5	----
Riboflavin supplement [1]	3.0	3.0
Alfalfa leaf meal	5.0	5.0
Ground limestone [2]	3.0	3.5
Steamed bonemeal	2.5	2.5
Manganized salt [3]	.7	.7
Vitamin-A-and-D feeding oil [5]	.3	.3
Total	100.0	100.0

See footnotes on p. 52.

FEEDING GROWING CHICKS

Chicks should be fed as soon as possible after removal from the incubator preferably within 48 hours. If a well-balanced diet is used, the feed may be kept before the chicks all the time. It is best to give the chicks at one time only as much as they will consume in a single day. There should be enough feeder space so that the chicks will not be crowded when feeding (fig. 13).

STARTING AND GROWING MASHES

MASH NO. 1

Ingredient	*Parts by weight*
Ground yellow corn	35.0
Ground wheat	20.0
Soybean oil meal	27.0
Fish meal	3.0
Meat scrap	3.0
Alfalfa leaf meal	5.0
Riboflavin supplement [1]	2.7
Steamed bonemeal	2.0
Ground limestone [2]	1.2
Manganized salt [3]	1.0
Vitamin-A-and-D feeding oil [5]	.1
Total	100.0

MASH NO. 2

Ingredient	*Parts by weight*
Ground yellow corn	32.0
Finely ground oats	10.0
Wheat middlings	10.0
Wheat bran	5.0
Soybean oil meal	28.0
Fish meal	3.0
Alfalfa leaf meal	5.0
Riboflavin supplement [1]	2.7
Steamed bonemeal	2.0
Ground limestone [2]	1.2
Manganized salt [3]	1.0
Vitamin-A-and-D feeding oil [5]	.1
Total	100.0

See footnotes on p. 52.

Any grain mixture suitable for chicks may be fed with these mashes after the chicks are 6 weeks old. The quantity of grain should then be gradually increased until equal proportions of grain and mash are being fed at 15 weeks of age.

It is not necessary to supply green feed with these mashes, but if there is plenty of green feed available, corn, oats, or barley may be substituted for the alfalfa leaf meal in the mashes.

If the chickens get plenty of sunlight and good green feed, the vitamin A and D oil may be omitted after the third or fourth week.

FIGURE 13.—Chicks feeding from a trough that is too small for the number of chicks to be fed. There should be enough feeder space to allow each chick to get its share of feed.

FEED FOR FATTENING CHICKENS

Chickens that are being fattened should be fed 2 or 3 times a day at regular intervals. They should be confined in a small pen or preferably in fattening batteries.

Mashes for fattening broilers:

FINISHING MASH NO. 1

Ingredien	*Parts, by weight*
Ground corn	42.0
Finely ground barley or oats	30.0
Meat scrap	13.0
Dried buttermilk or dried skim milk	7.0
Alfalfa leaf meal	5.0
Corn oil	2.5
Salt	.5
Total	100.0

FINISHING MASH NO. 2

Ingredient	*Parts, by weight*
Ground wheat	43.5
Finely ground barley or oats	30.0
Meat scrap	11.0
Dried buttermilk or dried skim milk	7.0
Alfalfa leaf meal	5.0
Corn oil	3.0
Salt	.5
Total	100.0

The corn oil is desirable but not essential; hence, if it is not available, it may be omitted. Mix these mashes with enough water to give the feed such a consistency that it will just pour readily. If liquid skim milk or buttermilk is available, it may be used in place of the water and the dried buttermilk or skim milk may be omitted from the mash.

Suitable mashes for fattening roasting chickens, capons, and fowls may be mixed according to the above formulas, except that only about one-half the quantity of meat scrap should be given.

HANDY INFORMATION AND REFERENCE TABLES

COMMON FEEDS AND THEIR SUBSTITUTES

The following tabulation indicates feedstuffs which may usually be substituted in livestock rations for some of the most common feeds.

Feed:	*Feeds that may be substituted, quantities depending on relative feeding value*
Whole milk	For older animals skim milk supplemented with ground grains. Mature animals may be given buttermilk and whey. The dam's milk or cow's milk properly modified, is best for very young animals. Dried skim milk or dried buttermilk may be used also.
Corn	Barley, kafir, milo, sorghum, oats, buckwheat, rice, or similar feeds rich in carbohydrates and fats.

Feed—Continued.	*Feeds that may be substituted, quantities depending on relative feeding value*
Oats	Bran, coarse middlings, distillers' dried grains, dried brewers' grains, or feeds having similar physical and nutritive qualities.
Wheat bran	Ground oats, other bran, distillers' dried grains, coarse middlings, alfalfa meal, or feeds having similar nutritive and physical qualities.
Linseed-oil meal	Peanut-oil meal, corn-gluten feed, copra meal, cottonseed meal (for some animals), velvetbean meal, soybean-oil meal, or similar feeds high in protein and mineral matter.
Cottonseed meal	Cottonseed cake, linseed-oil meal, peanut-oil meal, corn-gluten meal, copra meal, velvetbean meal, soybean-oil meal, or similar feeds high in protein and mineral matter.
Tankage	Fish meal, shrimp bran, meat scrap, or similar feeds high in protein and mineral matter.
Corn silage	Sorghum silage, other silage, pasture, roots, and green forage crops, or similar feeds.
Pasture	Silage, good-quality green hay, roots, or forage crops are good supplements. (There is no practical substitute for pasture in most sections if economy is considered.)
Clover hay	Other legume hays, such as alfalfa, lespedeza, peanut, soybean, cowpea, or velvetbean hay.
Timothy hay	Other grass hays, mixed hays, oats, wheat, or other grain hay, or similar roughages.
Corn stover	Other stovers, grass hays, oat straw, or similar roughages.
Oats straw	Corn stover, other stovers, barley straw and other straws, cottonseed hulls, and similar feeds.

WEIGHTS AND MEASURES OF COMMON FEEDS

In calculating rations and mixing concentrates it is usually necessary to use weights rather than measures. However, in feeding livestock it is often more convenient for the farmer to

measure the concentrates. The following tabulation will serve as a guide in feeding by measure:

WEIGHTS, IN POUNDS, PER QUART (DRY MEASURE) AND PER BUSHEL ARE AS FOLLOWS:

Feed:	*Approximate weight*	
	Lbs. per quart	*Lbs. per bushel*
Alfalfa meal	0.6	19
Barley	1.5	48
Beet pulp (dried)	.6	19
Brewers' grain (dried)	.6	19
Buckwheat	1.6	50
Buckwheat bran	1	29
Corn, husked ear	---	70
Corn, cracked	1.6	50
Corn, shelled	1.8	56
Corn meal	1.6	50
Corn-and-cob meal	1.4	45
Cottonseed meal	1.5	48
Cowpeas	1.9	60
Distillers' grain (dried)	.6	19
Fish meal	1	35
Gluten feed	1.3	42
Linseed-oil meal (old process)	1.1	35
Linseed-oil meal (new process)	.9	29
Meat scrap	1.3	42
Molasses feed	.8	26
Oats	1.0	32
Oats, ground	.7	22
Oat middlings	1.5	48
Peanut meal	1	32
Rice bran	.8	26
Rye	1.7	56
Soybeans	1.8	60
Tankage	1.6	51
Velvetbeans, shelled	1.8	60
Wheat	1.9	60
Wheat bran	.5	16
Wheat middlings, standard	.8	26
Wheat screenings	1.0	32

SOME FEEDING TERMS EXPLAINED

Balanced Ration.—A ration which contains nutrients of all essential kinds in quantities sufficient for the performance, with greatest efficiency, of those functions for which it is fed.

Carbohydrates and Fat.—Nutrients which produce fat, heat, and power to do work when consumed by animals. Fat is about 2¼ times as valuable in producing heat and power as carbohydrates. Feeds containing large quantities of starch and sugar are rich in carbohydrates, whereas large quantities of fat are contained in oily feeds.

Concentrates.—Feeds such as grains, linseed-oil meal, tankage, and other byproducts, which supply a large proportion of digestible nutrients per unit weight.

Crude Fiber.—The coarse, fibrous portions of plants, composed largely of carbohydrates, which are less digestible than others.

Legumes.—Plants, such as clover, alfalfa, cowpeas, and soybeans which have on their roots nodules containing bacteria capable of taking nitrogen from the air and making it available to the plants. Legumes are generally richer in protein and minerals than other roughage.

Minerals.—Nutrients used by the animal in building its skeleton and for other special purposes. Legume hays, bran, linseed meal, cottonseed meal, meat scrap, tankage, and other feeds contain relatively large quantities of minerals. Ground limestone is a good source of calcium, and bonemeal is a good source of calcium and phosphorus.

Nutrients.—Substances in feeds which nourish animals.

Proteins.—The name given to a class of nutrients which contain nitrogen and are used chiefly for the growth and maintenance of the animal body. Lean meat, skim milk, wheat bran, linseed meal, cottonseed meal, fish meal, meat scrap, and tankage are some of the feeds which contain relatively large quantities of protein.

Ration.—The quantity of feed given an animal in any period of time, usually one day.

Roughages.—Feeds such as pasture, hay, straws, roots, and silage which are coarse and bulky in nature.

Soiling crop.—Any growing crops which are cut and fed to animals in a fresh condition.

Vitamins.—Substances occurring in feeds in very small quantities, which are necessary for growth, reproduction, and protection against certain diseases.

PROTEIN IN LIVESTOCK FEEDS

Since most American farm-grown feeds contain an excess of carbohydrates and have a scarcity of protein, the percentage of protein in feeds that have to be purchased is one of the best measures of the value of such feeds. The following tabulations classify some of the most common roughages and concentrates

according to their approximate protein content and will be a good guide in buying feeds. These tables will also be of help in planning rations where it is necessary to know the approximate quantity of protein contained in the various components of the ration.

Digestible protein content of common roughages are as follows:

LOW-PROTEIN ROUGHAGES

About 1 percent:
- Rye straw.
- Wheat straw.
- Oat straw.

About 3 percent:
- Corn fodder.
- Corn stover.
- Canada bluegrass hay.
- Clover straw.
- Cowpea straw.
- Soybean straw.
- Meadow fescue hay.
- Rye hay.
- Timothy hay.

About 5 percent:
- Buckwheat straw.
- Clover-and-timothy hay.
- Barley hay.
- Kafir fodder.
- Kentucky bluegrass hay.
- Millet hay.
- Mixed-grass hay.
- Oat hay.
- Orchard grass hay.
- Prairie hay.
- Redtop hay.
- Sweetcorn fodder.
- Wheat hay.

HIGH-PROTEIN ROUGHAGES

About 7 percent:
- Alsike clover hay.
- Emmer hay.
- Native western bluegrass hay.
- Peanut vine (without nuts).
- Red clover hay.
- Vetch-and-oats hay.

About 9 percent:
- Alfalfa hay (first cutting).
- Crimson clover hay.
- Lespedeza hay.
- Peas-and-oats hay.

About 11 percent:
- Alfalfa hay (second cutting).
- Alfalfa meal.
- Red clover hay (before bloom).
- Sweetclover hay.
- Soybean hay.
- Vetch hay (common vetch).

About 13 percent:
- Cowpea hay.
- Canadian field pea hay.
- Velvetbean hay.

About 15 percent:
- Alfalfa hay (before bloom).
- Alfalfa leaves.
- Hairy vetch hay.

DIGESTIBLE PROTEIN CONTENT OF COMMON CONCENTRATES

About 5 percent:
- Beet pulp (dry).
- Buttermilk.
- Corn-and-cob meal.
- Corn meal.
- Hominy feed.
- Skim milk.

About 10 percent:
- Alfalfa meal.
- Barley.
- Kafir grain.
- Molasses feeds.
- Oats.
- Rice polish.
- Rye.
- Sorghums, ground.

About 15 percent:
- Oatmeal.
- Red dog flour.
- Sunflower seed (with hulls).
- Velvetbean meal (pods included).
- Wheat bran.
- Wheat middlings.

About 20 percent:
- Brewers' grain (dry).
- Coconut meal.
- Cowpeas.
- Distillers' grains (dried).
- Gluten feed.
- Fresh-ground bone.
- Peanut-oil meal (with hulls).

About 25 percent:
- Buckwheat middlings.
- Gluten meal (low grade).

About 30 percent:
- Linseed-oil meal.
- Soybeans.

About 35 percent:
- Gluten meal (high grade).
- Cottonseed meal.
- Meat-and-bone meal.

About 40 percent:
- Peanut-oil meal (without hulls).
- Soybean-cake meal (fat extracted).

About 45 percent:
- Peanut cake (from hulled nuts)

Above 45 percent:
- Tankage contains from 40 to 60 percent protein, depending on the method of manufacture. The guaranty tag states the protein content of tankage.
- Fish meal has about the same protein content as tankage.
- Dried blood may contain as much as 80 percent protein.

SIZE AND CAPACITY OF SILOS

The diameter of the silo should depend on the quantity of silage to be fed daily, whereas the height should be governed by the length of the feeding season. Hence, before constructing a silo the farmer should know approximately (1) the number of animals he intends to feed, (2) the quantity of silage to be fed daily, and (3) the number of days silage is to be fed.

In general, the height of the silo should not be less than twice nor more than three times the diameter. The diameter should be small enough to allow the removal of enough silage from the entire surface each day to prevent spoiling. When the weather is cold, feeding may be as slow as desired; in

the summer 3 inches or more should be removed daily. Table 1 shows the sizes of silo required for winter and summer with herds of different size when fed at rates ranging from 20 to 50 pounds per animal per day.

TABLE 1.—*Size of silo required for different sized herds of cattle when fed at various rates*

Number of animals	Quantity fed per animal daily	For a winter feeding period of 200 days		For a summer feeding period of 100 days	
		Total amount needed	Diameter and height of silo (inside measurements)	Total amount needed	Diameter and height of silo (inside measurements)
	Pounds	*Tons*	*Feet*	*Tons*	*Feet*
5	30	15	8 by 18	----------	----------
5	40	20	8 by 22	----------	----------
5	50	25	8 by 26	----------	----------
10	20	20	8 by 22	10	(1)
10	30	30	10 by 22	15	[2] 8 by 18
10	40	40	10 by 28	20	[2] 8 by 22
10	50	50	10 by 32 / 12 by 24	25	8 by 26
20	20	40	10 by 28	20	[2] 8 by 22
20	30	60	12 by 28	30	[2] 10 by 22
20	40	80	12 by 36 / 14 by 28	40	10 by 28
20	50	100	14 by 34	50	10 by 32 / 12 by 24
30	20	60	12 by 28	30	[2] 10 by 22
30	30	90	14 by 30	45	10 by 30
30	40	120	14 by 40 / 16 by 32	60	12 by 28
30	50	150	16 by 38	75	12 by 34
40	20	80	12 by 36 / 14 by 28	40	10 by 28
40	30	120	14 by 40 / 16 by 32	60	12 by 28
40	40	160	16 by 40	80	12 by 36 / 14 by 28
40	50	200	16 by 48 / 18 by 40	100	14 by 34
50	20	100	14 by 34	50	10 by 32 / 12 by 24
50	30	150	16 by 38	75	12 by 34
50	40	200	16 by 48 / 18 by 40	100	14 by 34
50	50	250	18 by 48	125	14 by 40 / 16 by 32

[1] A silo that would hold only 10 tons or less would be too small to be practicable
[2] Too low to permit 3 inches to be removed daily. Removal of less than 3 inches daily is not practicable for summer feeding.

The silage required in the summer will be only about half that required in the winter. If the silage for both seasons is all to be made at one time and the herd is not so large as to require more than two silos, then the silo for summer use should be smaller than the one for winter usee. But if the silage to be fed in the summer is made in the spring and that to be fed in the winter is made in the fall, then the two silos can be the same size; both would be filled in the fall and only one in the spring.

TO DETERMINE QUANTITY OF HAY IN A RICK

Generally, 512 cubic feet of hay in a stack or mow weigh 1 ton. To determine with reasonable accuracy the number of tons of hay in a rick of average shape, multiply the over—that is, the distance from the ground on one side to the ground on the other—by the width, then the length, and then by 0.37. This will give the number of cubic feet; then divide by 512 to get the number of tons in the stack.

TABLE 2.—*The percentage of composition of feedstuffs used in animal feeding*

GRAINS, SEEDS, AND MILL CONCENTRATES

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Barley	9.6	2.9	12.8	2.3	5.5	66.9	0.07	0.32
Barley feed	7.9	4.9	15.0	4.0	13.7	54.5	.03	.41
Bread, kiln dried	10.5	2.1	12.5	1.6	.4	72.9	.03	.12
Brewers' dried grains:								
18–23-percent protein	7.9	4.1	20.7	7.2	17.6	42.5	.16	.47
23–28-percent protein	7.7	4.3	25.4	6.3	16.0	40.3	.16	.47
Brewers' rice	11.6	.7	7.0	.8	.6	79.3	.03	.25
Buckwheat	12.6	2.0	10.0	2.2	8.7	64.5	----	----
Buckwheat middlings	12.4	4.6	28.0	6.6	5.3	43.1	----	----
Cocoa shells	9.2	8.2	16.4	5.4	15.8	45.0	----	----
Coconut cake	10.7	4.0	19.1	11.0	14.1	41.1	----	----
Coconut meal, old process	7.3	5.5	21.3	10.0	9.4	46.5	.28	.58
Coconut meal, new process	8.9	6.6	21.4	2.4	13.3	47.4	.28	.58
Corn, shelled	12.9	1.3	9.3	4.3	1.9	70.3	.01	.26
Corn bran	10.0	2.1	10.0	6.6	8.8	62.5	.03	.14

[1] Fat.
[2] Carbohydrates except fiber.
[3] Leaders indicate that data are lacking.

TABLE 2.—*The percentage of composition of feedstuffs*—Contd.

GRAINS, SEEDS, AND MILL CONCENTRATES—CONTINUED

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Corn chop	11.3	1.4	9.8	4.1	2.1	71.3	0.01	0.26
Corn (ear) chop	10.7	2.0	8.2	3.4	9.2	66.5	------	------
Corn-feed meal	10.8	1.9	10.5	5.3	2.9	68.6	.04	.38
Corn-germ meal	7.0	3.8	20.8	9.6	7.3	51.5	.05	.59
Corn-gluten feed	9.5	6.0	27.6	3.0	7.5	46.4	.11	.78
Corn-gluten meal	8.0	2.2	43.0	2.7	3.7	40.4	.10	.47
Corn-oil meal	8.7	2.2	22.1	6.8	10.8	49.4	.06	.62
Cottonseed, whole pressed	6.5	4.3	29.6	5.8	25.1	28.7	------	------
Cottonseed cake	7.5	5.9	44.1	6.4	10.3	25.8	------	------
Cottonseed feed, 32 percent protein	8.3	4.8	32.1	6.4	15.3	33.1	.20	.73
Cottonseed hulls	8.7	2.6	3.5	1.0	46.2	38.0	------	------
Cottonseed meal:								
33–38-percent protein	7.4	5.2	36.6	5.6	15.3	29.9	.28	1.30
38–43-percent protein	7.3	6.1	41.0	6.5	11.9	27.2	.19	1.11
Over 43-percent protein	7.2	5.8	43.7	6.5	11.1	25.7	.18	1.15
Distillers' (corn) dried grain	7.0	2.4	28.3	9.4	14.6	38.3	.04	.29
Distillers' (rye) dried grain	6.1	2.4	17.9	6.3	15.9	51.4	.13	.43
Feterita	9.1	1.7	14.2	2.9	1.4	70.7	------	------
Hemp cake	10.8	18.0	30.8	10.2	22.6	7.6	------	------
Hempseed, European	8.8	18.8	21.5	30.4	15.9	4.6	------	------
Hominy feed	9.5	2.9	11.2	8.3	6.3	61.8	.03	.44
Kafir	11.9	1.7	11.1	3.0	2.3	70.0	.01	.25
Kafir-head chops	10.4	3.9	10.9	2.5	6.0	66.3	.09	.20
Linseed-oil meal:								
33–38 percent protein	8.5	5.6	35.3	5.4	8.3	36.9	.36	.84
38–43 percent protein	8.5	5.3	40.4	5.8	7.5	32.5	.33	.74
Malt	7.7	2.9	12.4	2.1	6.0	68.9	------	------
Malt sprouts	7.3	6.1	28.1	1.8	13.3	43.4	.26	.68
Mesquite beans and pods	6.6	4.5	13.0	2.7	22.8	50.4	------	------
Millet, foxtail	10.1	3.3	12.6	4.3	8.4	61.3	------	------
Millet, proso or hog millet	9.8	3.4	12.0	3.4	7.9	63.5	------	------
Milo	9.3	1.6	12.5	3.2	1.5	71.9	------	------
Milo-head chops	10.4	4.3	10.7	2.6	7.1	64.9	------	------
Molasses, cane	24.0	6.8	3.1	------	------	66.1	.35	.06
Oats, grain	7.7	3.5	12.5	4.4	11.2	60.7	.10	.40
Oat chops	8.9	3.9	12.8	5.0	11.8	57.6	.10	.36
Oat clips	9.0	9.3	11.8	4.5	22.7	42.7	------	------
Oat groats, ground rolled	10.4	2.6	17.3	6.6	1.8	61.3	.08	.43
Oat hulls	5.8	6.5	4.3	1.9	30.8	50.7	.09	.12
Oatmeal	8.9	2.3	16.5	4.8	3.6	63.9	.08	.43
Oat millfeed	6.9	6.0	6.3	2.2	27.9	50.7	.20	.22
Palm kernel	8.4	1.8	8.4	48.8	5.8	26.8	------	------
Palm-kernel cake	10.1	3.9	16.2	11.0	21.4	37.4	------	------
Peanuts, kernels	5.5	2.3	30.2	47.6	2.8	11.6	.06	.38
Peanuts, shells on	6.0	2.8	24.7	33.1	18.0	15.4	------	------

TABLE 2.—*The percentage of composition of feedstuffs*—Contd.

GRAINS, SEEDS, AND MILL CONCENTRATES—CONTINUED

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Peanut meal:								
38–43 percent protein	6.4	4.4	41.6	7.2	16.0	24.4	0.10	0.50
43–48 percent protein	6.7	4.6	45.1	7.2	14.2	22.2	.17	.55
Over 48 percent protein	7.0	5.0	51.4	4.8	9.2	22.6	------	------
Rapeseed, brown Indian	5.7	6.4	21.0	41.2	12.5	13.2	------	------
Rapeseed, common	7.3	4.2	19.5	45.0	6.0	18.0	------	------
Rice, rough	9.7	5.4	7.3	2.0	8.6	67.0	.10	.10
Rice, bran	8.8	12.2	12.8	13.8	12.2	40.2	.10	1.84
Rice hulls	6.5	21.9	2.1	.4	44.8	24.3	.08	.06
Rice polish	10.0	7.6	12.4	13.2	2.8	54.0	.03	1.52
Rice-stone bran	8.4	11.9	12.5	13.0	11.1	43.1	------	------
Rye	9.5	1.9	11.1	1.7	2.1	73.7	.04	.37
Rye feed	10.2	4.0	15.6	3.2	4.3	62.7	------	.59
Rye middlings	9.5	4.4	16.7	3.7	5.5	60.2	------	------
Sesame seed	5.5	6.5	20.3	45.6	7.1	15.0	------	------
Sesame-seed cake	9.8	10.7	37.5	14.0	6.3	21.7	------	------
Sorgo	12.8	2.1	9.1	3.6	2.6	69.8	------	------
Soybeans	8.0	4.8	38.9	18.0	4.8	25.5	.22	.67
Soybean-oil meal:								
38–43 percent protein	7.8	5.8	41.7	5.8	6.2	32.7	.29	.67
43–48 percent protein	8.2	6.0	44.7	4.6	5.8	30.7	.34	.71
Sunflower seed	6.9	3.2	15.2	28.8	28.5	17.4	------	------
Sunflower hulls	10.5	2.6	4.4	3.4	57.0	22.1	------	------
Sunflower kernels	6.9	4.2	29.4	43.9	2.6	13.0	------	------
Velvetbeans	9.8	3.1	26.2	4.8	6.0	50.1	------	------
Vinegar grains	6.8	2.9	19.5	7.0	17.3	46.5	------	------
Wheat	10.6	1.8	12.0	2.0	2.0	71.6	.05	.38
Wheat bran	9.4	6.4	16.4	4.4	9.9	53.5	.10	1.14
Wheat, brown shorts	10.8	4.0	17.8	4.8	5.8	56.8	------	------
Wheat-flour middlings	10.4	3.3	18.8	4.0	4.2	59.3	.09	.80
Wheat, gray shorts	11.0	4.1	17.5	4.4	5.4	57.0	.08	.86
Wheat, mixed feed	9.9	4.4	18.2	4.4	6.9	56.1	.11	.96
Wheat, red dog	11.1	2.2	18.3	3.4	2.3	62.7	.12	.83
Wheat, standard middlings	10.4	3.9	17.0	4.3	5.4	59.0	.09	90
Wheat, white shorts	10.9	2.2	15.6	3.7	2.4	65.2	------	------
Wheat waste, shredded	8.0	1.6	12.4	1.6	2.6	73.8	------	------
Yeast cells, dried	4.3	10.7	48.5	.5	.5	35.5	.42	1.90
ANIMAL, MARINE, AND MILK PRODUCTS								
Beef meal	8.0	13.0	70.6	9.1	0	0	------	------
Blood meal	14.4	4.7	78.4	.6	.8	1.1	0.35	0.24
Bone, green, horse	59.0	20.4	19.2	.4	0	0	------	------
Bone, green, butchershop	52.0	16.3	16.6	17.0	0	0	------	------
Bonemeal, raw	6.7	62.1	25.2	3.3	1.4	1.3	24.20	11.5
Bonemeal, steamed	3.1	83.6	6.2	2.2	1.3	3.6	30.00	13.9

TABLE 2.—*The percentage of composition of feedstuffs*—Contd.

ANIMAL, MARINE, AND MILK PRODUCTS—CONTINUED

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Bonemeal, special steamed	2.7	75.1	11.1	6.5	1.7	2.9	27.00	13.20
Buttermilk	91.0	.7	3.0	.5	------	4.8	.13	.09
Buttermilk, dried	5.5	9.4	34.3	7.0	.3	43.5	1.32	.93
Crab meal	8.4	37.1	37.9	3.1	8.4	5.1	------	------
Fish meal	7.1	17.7	62.0	7.3	.6	5.3	4.31	2.68
Fish meal, menhaden	7.1	25.7	57.8	6.2	2.4	.8	------	------
Fish meal, sardine	6.7	13.4	68.1	4.3	.5	7.0	------	------
Fish, whiting	71.0	5.4	18.8	4.0	1.7	0	------	------
Lips, ox	71.0	1.5	19.0	9.5	0	0	------	------
Liver, hog	72.8	------	19.8	5.3	0	0	------	------
Liver meal	6.4	7.5	67.2	14.6	1.9	2.4	------	------
Lungs, beef	79.7	1.0	16.1	3.2	0	0	------	------
Lungs, calf	76.8	1.1	16.1	5.0	0	0	------	------
Meat, horse muscle	75.0	1.1	20.2	2.9	0	0	------	------
Meat, beef muscle	72.0	1.0	21.2	5.2	0	0	------	------
Meat and bone scraps:								
42–48 percent protein	6.1	31.6	46.8	11.8	2.1	1.6	11.2	5.06
48–53 percent protein	6.4	30.5	50.4	9.7	2.0	1.0	10.5	5.21
53–58 percent protein	6.1	25.5	54.9	11.1	2.1	.3	8.26	4.02
Meat scraps:								
48–53 percent protein	5.7	28.0	51.0	12.0	1.6	1.7	------	------
53–58 percent protein	6.3	26.7	55.0	9.1	2.2	.7	8.70	4.30
Melts, beef	75.0	1.5	19.0	2.0	0	0	------	------
Melts, pork	78.0	1.5	17.5	2.0	0	0	------	------
Milk, skim	91.1	.8	3.4	.2	0	4.5	.13	.10
Milk, skim, dried	4.7	8.8	35.8	1.0	.1	49.6	1.34	.99
Milk, whole	87.1	.7	3.6	3.7	0	4.9	.12	.09
Shrimp meal	10.7	33.4	38.5	2.6	11.7	3.1	7.71	1.31
Tankage, digester:								
53–58 percent protein	7.6	21.8	55.8	10.4	2.5	1.9	8.92	4.22
Over 58 percent protein	6.8	19.5	61.6	8.6	1.7	1.8	7.07	3.72
Tankage, digester with bone:								
38–43 percent protein	6.4	32.4	40.0	14.1	3.0	4.1	------	------
43–48 percent protein	6.3	31.3	46.0	12.5	1.9	2.0	------	------
48–53 percent protein	5.8	28.6	51.2	10.4	1.6	2.4	------	------
Over 53 percent protein	6.2	24.2	54.5	10.3	1.7	3.1	9.24	4.15
Tripe, raw	86.5	.3	11.7	1.2	0	.3	------	------
Viscera, horse (includes blood)	77.0	1.1	19.8	1.2	0	0	------	------
Whey	93.8	.4	.6	.1	0	5.1	.04	.04
Whey, dried	6.7	10.1	12.8	.6	.2	69.6	.73	.66
GREEN FORAGES								
Alfalfa, immature	79.4	2.9	5.2	0.7	3.8	8.0	0.28	0.09
Alfalfa, in bloom	77.2	1.8	3.2	.6	7.8	9.4	.39	.07
Alsike clover, immature	81.2	2.4	4.9	.6	3.1	7.8	.26	.09

TABLE 2.—*The percentage of composition of feedstuffs*—Contd.

GREEN FORAGES—CONTINUED

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Alsike clover, in bloom	74.8	2.0	3.9	0.9	7.4	11.0	0.21	0.06
Barley, immature	83.4	1.5	2.8	.7	3.6	8.0	.06	.07
Barley, mature	77.1	1.6	2.2	.5	6.4	12.2	.05	.07
Bluegrass, Kentucky, immature	70.5	2.5	5.0	1.2	7.5	13.3	.15	.13
Bromegrass, immature	77.5	2.9	4.3	.9	5.2	9.2	.14	.10
Cabbage	90.5	.9	2.4	.3	1.2	4.7	.06	.02
Canada bluegrass, immature	74.1	2.5	4.3	1.3	6.8	11.0	.11	.12
Corn fodder:								
Dent, immature	79.0	1.2	1.7	.5	5.6	12.0	------	------
Dent, mature	73.4	1.5	2.0	.9	6.7	15.5	------	------
Flint, immature	79.8	1.1	2.0	.7	4.3	12.1	------	------
Flint, mature	77.1	1.1	2.1	.8	4.3	14.6	------	------
Cowpeas	82.5	2.5	3.4	.5	4.0	7.1	.18	.05
Crimson clover	80.9	1.7	3.1	.7	5.2	8.4	.28	.04
Kafir	73.0	2.0	2.3	.7	6.9	15.1	------	------
Lespedeza, Korean, immature	74.1	2.4	4.6	.8	5.8	12.3	.34	.11
Meadow fescue, immature	78.8	2.6	4.0	.9	4.7	9.0	.15	.11
Meadow foxtail, immature	73.9	2.8	4.5	1.2	5.6	12.0	.15	.12
Millet, foxtail	71.1	1.7	3.1	.7	9.2	14.2	.09	.05
Oatgrass, tall, immature	78.4	3.0	4.3	1.0	4.6	8.7	.11	.13
Oats, immature	82.6	1.7	2.9	.7	3.3	8.8	.07	.07
Oats, mature	72.0	2.1	2.7	.9	7.4	14.9	.08	.08
Orchard grass, immature	78.3	2.8	3.4	1.0	5.3	9.2	.14	.13
Orchard grass, in bloom	73.0	2.0	2.6	.9	8.2	13.3	------	------
Pricklypear	78.9	4.3	.7	.4	2.6	13.1	------	------
Rape	85.7	2.0	2.4	.6	2.2	7.1	------	------
Red clover, immature	81.2	2.7	5.0	.8	3.0	7.3	.27	.10
Red clover, in bloom	70.8	2.1	4.4	1.1	8.1	13.5	.44	.07
Red fescue, immature	70.5	2.8	4.1	.9	8.2	13.5	.16	.13
Red top, immature	76.8	2.8	4.1	.9	5.4	10.0	.15	.10
Reed canary grass, immature	80.7	2.4	3.5	.7	4.3	8.4	.13	.10
Rye, immature	80.8	2.3	4.5	1.1	3.4	7.9	.10	.10
Rye, mature	76.6	1.8	2.6	.6	11.6	6.8	.08	.06
Rye grass, Italian, immature	77.3	2.5	3.5	1.0	5.2	10.5	.13	.12
Rye grass, perennial, immature	75.9	3.0	3.8	.9	5.4	11.0	.15	.12
Sorgo	77.3	1.3	1.5	1.0	6.2	12.7	------	------
Soybeans	73.9	2.9	4.0	1.1	7.6	10.5	.28	.05
Sweetclover, immature	75.3	2.2	5.3	.7	6.7	9.8	.26	.07
Sweet corn	79.1	1.3	1.9	.5	4.4	12.8	------	------
Timothy, immature	74.9	2.3	4.1	.9	5.4	12.4	.12	.11
Timothy, in bloom	61.6	2.1	3.1	1.2	11.8	20.2	.13	.05
Wheat, immature	82.3	2.1	3.8	.9	3.0	7.9	.07	.10
Wheat, mature	68.7	2.6	2.4	.7	8.6	17.0	.06	.08
White clover, immature	82.0	2.1	4.9	.6	3.1	7.3	.23	.09
White clover, wild, immature	81.2	2.2	5.2	.6	2.9	7.9	.25	.10

TABLE 2.—*The percentage of composition of feedstuffs*—Contd.

DRIED FORAGES

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Alfalfa hay	7.2	8.0	15.4	1.6	30.3	37.5	1.51	0.21
Alfalfa-leaf meal	8.5	14.4	20.9	2.6	15.7	37.9	1.42	.25
Alfalfa meal	8.2	10.0	15.2	2.2	27.5	36.9	1.56	.22
Alfalfa meal, dehydrated	6.6	10.0	16.9	2.6	25.4	38.5		
Alfalfa-stem meal	9.1	7.7	11.4	1.3	36.1	34.4		
Alsike clover hay	10.5	8.8	14.4	2.5	24.7	39.1	.78	.20
Australian saltbush hay	6.7	16.9	16.1	1.8	21.5	37.0		
Barley hay	15.0	6.4	6.7	1.6	21.4	48.9	.17	.25
Barley straw	14.2	5.7	3.5	1.5	36.0	39.1		
Bermuda grass hay	8.9	7.9	7.2	1.7	24.9	49.4	.60	.16
Black grama hay	5.5	7.0	4.3	1.3	31.4	50.5	.22	.09
Blue grama hay	10.9	8.5	6.7	1.8	27.9	44.2		
Bluegrass hay, immature	7.3	7.9	15.2	3.0	23.7	42.9	.45	.35
Bluegrass hay, bloom	11.9	7.0	9.3	3.4	27.9	40.5	.30	.21
Bluejoint grass hay	7.5	6.9	6.7	3.0	34.2	41.7		
Bromegrass hay	14.0	9.7	9.3	1.8	26.6	38.6		
Buckwheat straw	9.9	5.5	5.2	1.3	43.0	35.1		
Buffalo grass hay	6.2	10.8	5.6	1.7	26.1	49.6		
Bur-clover hay	8.7	12.3	15.7	3.0	25.5	34.8	1.11	.15
Corncobs	10.7	1.4	2.4	.5	30.1	54.9		
Corn fodder	11.8	5.8	7.4	2.4	23.0	49.6		
Corn husks	9.8	2.9	2.9	.7	30.7	53.0		
Corn leaves	11.8	8.5	8.1	2.2	24.4	45.0		
Cornstalks	11.7	4.6	4.8	1.8	32.7	44.4		
Corn stover	10.7	6.1	5.7	1.5	30.3	45.7	.45	.10
Cowpea hay	9.7	12.9	17.5	2.8	20.5	36.6	1.84	.25
Cowpea straw	9.7	5.3	7.4	1.3	41.5	34.8		
Crabgrass hay	9.0	7.9	6.5	2.2	32.1	42.3	.33	.17
Crimson clover hay	9.6	8.6	15.2	2.8	27.2	36.6	1.18	.13
Feterita fodder	13.3	6.4	8.7	1.9	21.5	48.2	.27	.19
Field-pea hay	10.6	8.3	16.1	2.7	24.8	37.5		
Flax straw	6.2	3.8	7.8	2.1	46.9	33.2		
Hegari fodder	13.5	8.2	6.2	1.7	16.7	53.7	.17	.18
Hegari stover	15.1	9.7	4.5	1.9	26.6	42.2	.38	.09
Johnson grass hay	7.2	7.2	8.1	2.8	30.4	44.3	.55	.40
Kafir fodder	9.1	7.8	6.6	2.1	28.4	46.0	.31	.05
Kafir stover	12.6	9.0	5.8	1.7	27.5	43.4		
Lespedeza hay	7.9	6.2	11.9	2.8	28.5	42.7	.80	.25
Little bluestem hay	8.6	4.9	4.0	1.6	35.4	45.5		
Meadow fescue hay	11.6	7.0	6.6	2.0	31.6	41.2		
Millet hay, foxtail	7.0	8.2	9.2	2.8	28.0	44.8		
Millet hay, pearl or cattail	10.1	9.7	9.0	1.8	32.3	37.1		
Natal grass hay	7.5	4.8	3.7	1.4	39.5	43.1	.49	.32
Oatgrass, tall, hay	8.1	6.4	9.4	2.7	29.8	43.6		
Oat hay	11.8	5.7	6.1	2.4	27.1	46.9	.27	.22
Oat straw	8.1	7.6	4.4	2.5	36.2	41.2	.23	.20
Orchard grass hay, immature	9.9	6.0	8.1	2.6	32.4	41.0	.31	.18

TABLE 2.—*The percentage of composition of feedstuffs*—Contd.

DRIED FORAGES—CONTINUED

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Orchard grass hay, mature	9.9	7.0	6.9	3.0	32.7	40.5	.....	.....
Prairie hay (Colorado, Wyoming)	5.5	7.2	7.0	2.4	31.3	46.6	.....	.....
Prairie hay (Kansas, Oklahoma)	9.5	7.5	4.4	2.3	30.4	45.9	.55	.07
Prairie hay (Minnesota, South Dakota)	11.6	7.2	6.0	2.4	30.3	42.5	.44	.11
Red clover hay	7.0	10.0	16.1	2.6	23.6	40.7	1.01	.14
Red clover, mammoth, hay	12.2	7.5	12.8	3.3	27.1	37.1	.....	.....
Red top hay	8.9	5.2	7.9	1.9	28.6	47.5	.35	.18
Rhodes grass hay	8.6	8.4	5.3	1.2	33.4	43.1	.....	.....
Rice straw	8.9	13.5	4.5	1.6	34.0	37.5	.18	.05
Rye hay	6.4	4.7	5.9	2.0	37.4	43.6	.27	.22
Rye straw	7.1	3.2	3.0	1.2	38.9	46.6	.....	.....
Rye grass, perennial, hay	10.2	8.6	8.6	4.1	24.5	44.0	.17	.11
Rye grass, Italian, hay	8.5	6.9	7.5	1.7	30.5	44.9	.....	.....
Rye grass hay	8.3	8.5	6.3	2.0	33.0	41.9	.....	.....
Sedge, western species	5.4	6.7	11.6	2.4	27.4	46.5	.....	.....
Slender wheatgrass	7.5	6.6	7.8	2.1	30.8	45.2	.....	.....
Sorgo fodder	11.6	6.0	5.3	2.4	26.0	48.7	.27	.15
Sorgo hay	5.8	9.5	9.5	1.9	26.8	46.5	.31	.09
Soybean hay	8.4	8.9	15.8	3.8	24.3	38.8	1.26	.22
Soybean straw	8.7	7.4	5.7	2.5	34.6	41.1	.....	.....
Sudan grass hay	5.3	8.1	9.7	1.7	27.9	47.3	.47	.24
Sweetclover hay	8.1	7.5	16.2	2.8	25.9	39.5	.74	.08
Sweetclover straw	5.1	3.4	6.7	1.2	49.6	34.0	.....	.....
Timothy hay	7.1	5.8	7.5	2.9	30.2	46.5	.31	.13
Vetch, hairy hay	13.1	8.4	20.9	2.7	24.2	30.7	.25	.30
Western needlegrass hay	9.9	6.2	5.5	2.7	33.2	42.5	.....	.....
Western wheatgrass hay	8.6	8.7	8.4	2.3	31.9	40.1	.....	.....
Wheat hay	9.6	4.2	3.4	1.3	38.1	43.4	.14	.15
Wheat straw	6.8	5.4	4.3	3.4	36.8	43.3	.....	.....
White clover hay	7.2	9.4	15.6	2.2	22.7	42.9	1.31	.28
Wire grass hay	8.5	7.3	6.6	1.3	34.6	41.7	.....	.....

TABLE 2.—*The percentage of composition of feedstuffs*—Contd.

SILAGES, ROOTS, TUBERS, AND BYPRODUCTS

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Alfalfa silage	68.9	2.7	5.7	1.0	8.8	12.9		
Alfalfa-molasses silage	68.6	3.4	5.8	1.0	8.4	12.8		
Apple pomace	78.6	.6	1.3	1.2	3.7	14.6	.02	.01
Apple silage	87.6	.6	.7	.7	1.8	8.6		
Beet pulp, dried	9.2	3.2	9.3	.8	20.0	57.5	.66	.06
Beet pulp, molasses, dried	8.0	5.2	11.6	.7	16.4	58.1	.59	.09
Carrots	88.6	1.0	1.1	.4	1.3	7.6		
Cassava	63.8	1.4	1.0	.3	.8	32.7		
Corn silage	73.8	1.7	2.1	0.8	6.3	15.3	.08	.08
Corn silage, immature	79.1	1.4	1.7	.8	6.0	11.0		
Corn silage, mature	70.9	1.4	2.4	.9	6.9	17.5		
Corn stover silage	80.7	1.8	1.8	.6	5.6	9.5		
Cowpea silage	77.8	2.1	3.2	.9	6.5	9.5		
Hegari silage	66.3	3.4	2.3	.8	6.7	20.5		
Jerusalem artichokes	78.7	1.1	2.5	.2	.8	16.7		
Mangel-wurzel	90.8	1.0	1.4	.2	.9	5.7	.02	.02
Napier grass silage	67.5	1.8	1.2	.7	14.4	14.4	.10	.10
Parsnips	80.0	1.3	2.2	.4	1.3	14.8		
Pea-vine silage	75.1	1.7	3.0	.9	8.1	11.2		
Potatoes	78.9	1.0	2.1	.1	.6	17.3	.01	.06
Potatoes, dried	10.8	4.4	8.8	.4	2.3	73.3		
Red clover silage	72.0	2.6	4.2	1.2	8.4	11.6		
Rutabagas	88.6	1.2	1.2	.2	1.3	7.5	.05	.04
Sorgo silage	74.7	1.4	1.6	1.0	6.9	14.4	.09	.04
Soybean silage	75.6	2.6	2.4	.8	9.6	9.0	.29	.10
Sugar beets	78.0	1.0	1.5	.1	2.9	16.5	.05	.06
Sugar-beet pulp	90.5	.4	.9	.2	2.2	5.8		
Sunflower silage	77.9	2.1	1.8	1.6	6.5	10.1		
Sweetclover silage	70.2	2.9	6.1	1.0	9.7	10.1		
Sweetpotatoes	71.1	1.0	1.5	.4	1.3	24.7	.02	.05
Sweetpotatoes, dried	9.1	4.2	3.6	.8	3.1	79.2		
Turnips	90.6	.8	1.3	.2	1.2	5.9	.05	.05

TABLE 3.—*Concentrates to feed to cows not on pasture*

Quantity of milk produced daily, with a butterfat percentage of—								Daily concentrate allowance, when good hay or its equivalent [1] is fed at the following rate per 100 pounds of body weight—			
3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	3 pounds of hay	2½ pounds of hay	2 pounds of hay	1½ pounds of hay
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
10	9	7	7	6	5	4	4	0	0	1	4
12	11	10	9	7	7	6	6	0	0	2	5
15	14	12	11	9	9	8	7	0	0	3	6
19	17	15	13	11	11	9	8	0	1	4	7
21	19	17	15	13	12	11	10	0	2	5	8
24	22	19	17	15	14	13	12	0	3	6	9
26	24	21	19	17	16	14	13	1	4	7	10
29	27	24	21	19	18	16	15	2	5	8	11
32	29	26	23	21	20	18	16	3	6	9	12
34	31	28	25	23	21	19	18	4	7	10	13
37	34	30	27	25	23	21	19	5	8	11	14
40	36	32	29	26	25	23	21	6	9	12	15
42	39	35	31	28	26	24	23	7	10	13	16
45	41	37	33	30	28	26	24	8	11	14	17
48	43	39	36	32	30	28	26	9	12	15	18
50	46	41	38	34	32	29	27	10	13	16	19
53	48	44	40	36	34	31	29	11	14	17	20
56	51	46	42	38	35	32	30	12	15	18	21
58	53	48	44	40	37	34	32	13	16	19	22
61	55	50	46	42	39	36	33	14	17	20	23
63	58	52	48	44	41	37	35	15	18	21	24
66	60	55	50	45	43	39	37	16	19	22	25
69	63	57	52	47	44	41	38	17	20	23	26
71	65	59	54	49	46	42		18	21	24	27
74	67	61	56	51				19	22	25	28
77	70	63						20	23	26	29
79	72							21	24	27	30
82								22	25	28	
85								23	26	29	

[1] Three pounds of silage equals 1 pound of hay.

A PAGE OF CAUTIONS

Things Livestock Feeders Should Not Do

Don't withhold feed from young, growing animals when they want it.

Don't feed a ration containing corn alone to any class of stock.

Don't allow breeding animals to become so thin that you have to apologize for their condition.

Don't feed carcasses of animals that have died of disease to any of your stock or chickens.

Don't feed more grain mixture or concentrate than the animal will clean up quickly, except when forcing fattening animals.

Don't allow pregnant breeding animals to become too fat.

Don't use pastures too early in the spring and don't graze pastures too closely.

Don't let animals go thirsty.

Don't forget to salt all animals regularly.

Don't feed animals of different ages and sizes in the same pen or lot.

Don't let strong and aggressive animals rob the weak of the proper amount of feed.

Don't turn cattle or sheep on luxuriant clover when the dew is on.

Don't put fresh feed into dirty or sour troughs.

Don't allow dairy cows and laying hens to become fat.

Don't waste your surplus feeds.

Don't feed frozen, moldy, or spoiled silage.

Don't change an animal's ration abruptly.

Don't feed animals poorly because they are not producing; feed them and give them a chance.

Don't keep scrub and inferior stock; they are wasteful of feed.

BETTER FEEDING OF LIVESTOCK

Great numbers of farmers have expressed to the United States Department of Agriculture their interest in problems of better feeding, growth, and development of livestock.

This handbook has been prepared by Department feeding specialists for distribution to farmers who desire a handy-sized set of simple rules and reference tables to be followed in feeding the different classes of farm animals. It aims to aid farmers in understanding the principles of better feeding and in using the best practices which are adaptable to conditions on their farms.

No set of specific feeding rules can be wisely applied throughout the country. Local conditions, seasonal changes, and many other factors combine to make the best feeding practices change from place to place and from time to time. This handbook discusses the main points most commonly encountered in feeding but which should always be adapted to local conditions. More general discussions of feeding practices will be found in Farmers' Bulletins and other publications of the Department, also in publications of the State agricultural colleges and experiment stations.

JOHN R. MOHLER,
Formerly Chief, Bureau of Animal Industry.

HOW TO USE THIS HANDBOOK

For general information consult pages 1 to 19, which deal with the chief everyday problems of livestock feeders.

For directions for feeding the different animals consult pages 19 to 56, using the table of contents to find the kind in which you are interested.

For weight, measure, composition, and comparative values of feeds and explanation of feeding terms consult pages 56 to 71.